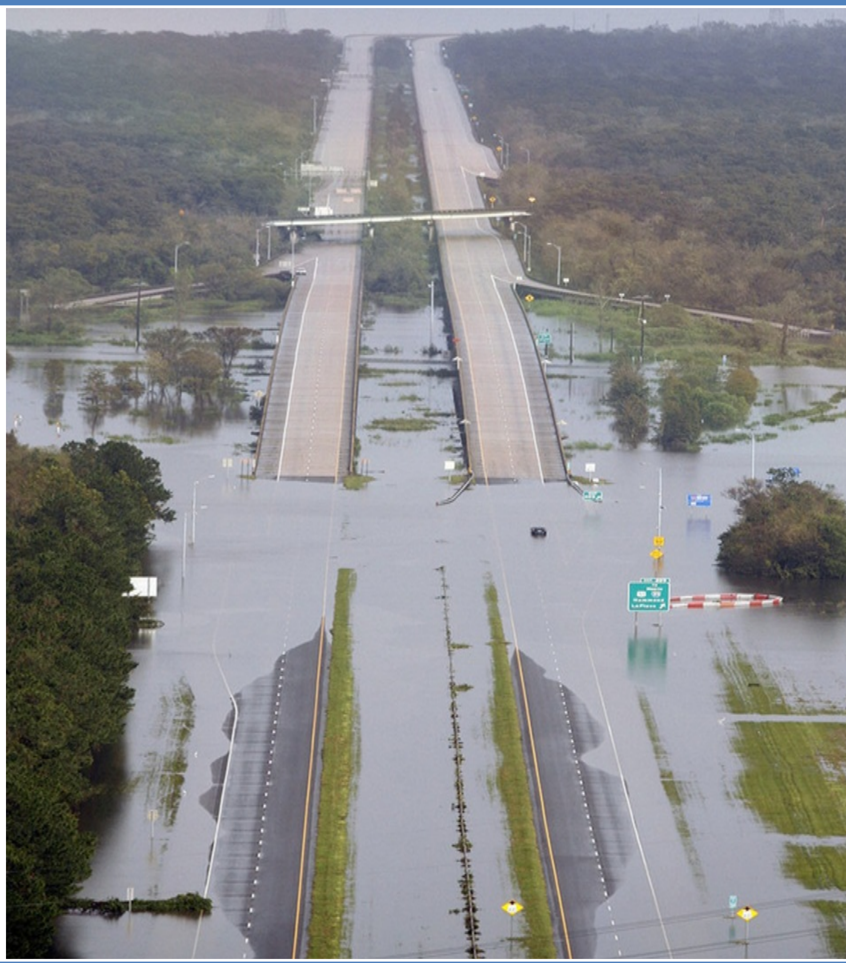
West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Study



Integrated Draft Feasibility Report and Environmental Impact Statement

US Army Corps of Engineers®

U.S. Army Corps of Engineers
Mississippi Valley Division
New Orleans District

August 2013

Hurricane Isaac flooding in Laplace, Louisiana.

The U.S. Army Corps of Engineers prepared this feasibility report and Environmental Impact Statement for the West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction study. The Pontchartrain Levee District is the non-Federal Sponsor of the study. The report includes input from the study sponsors, natural resource agencies and the public. It presents potential solutions to reduce damages from hurricane and tropical storm surge for 62,900 residents in St. Charles, St. John the Baptist and St. James Parishes, Louisiana.

The study area offers a bounty of natural resources but it was historically subject to flooding from the Mississippi River and nearby lakes. Colonial settlers built levees along the river starting in the 1700s to combat annual floods. River levees allowed colonists to settle the area, grow crops and harvest natural resources.

The management of Mississippi River flood risks and the development of interior drainage systems in the 20th century, allowed urban and suburban expansion into the region beyond the high ground found adjacent to the river. The study area has no coastal storm levees and remains susceptible to damages from surges resulting from hurricanes and tropical storms. Some natural buffer protection is afforded by a large cypress swamp that separates developed areas from nearby tidal lakes. The swamp has degraded over time and the buffer it provides between the lakes and towns is decreasing.

Population is increasing with suburban and industrial development along the river corridor between Baton Rouge and New Orleans. Residents are attracted to the area's employment opportunities, quality of life and access to recreation. Increasing population and degrading natural buffers combine to create risks of damages from hurricane and tropical storm surge events. Future sea level rise exacerbates the risks of damage from storm hurricane and tropical storm surge events. As a result, hurricane and tropical storm surge damage is a substantial risk today that is expected to increase over time.

In August 2012 Hurricane Isaac struck the region causing extensive rainfall and storm surge flooding in the study area. After the storm President Obama toured the damaged area and met with residents and community leaders. The storm illustrates the risks faced in low-lying study area communities. Thousands of residents and businesses were flooded and continue to work towards community recovery today.

Key industries are located in the river corridor. The Port of South Louisiana is the largest volume port in the Western Hemisphere and the ninth largest in the world. It stretches along the Mississippi River between New Orleans and Baton Rouge and plays a critical role in the export of agricultural commodities from the Nation's heartland. Hurricane Isaac disrupted port logistics. Storm surge blocked facility access closing the port for days. Oil refineries, including the Nation's third largest, were shut down during and after the storm. Gasoline and chemical production stopped impacting an important industrial sector that supports National energy security. Regional and national fuel prices spiked. The storm caused agricultural losses due to an inability to drain flooded fields. Storm surge flooded ground-level parts of Interstate 10 and access to Interstate 55. These are critical transportation routes that support the regional and national economies and that play an important role in emergency evacuation, repopulation and post-storm recovery.

Eleven management measures were crafted to address storm surge. Structural and non-structural features included levees, elevating buildings and restoring cypress swamp. Measures were combined into a dozen alternative plans. A focused array of four alternative plans was evaluated under SMART Planning. Alternatives A and C are comprised of non-structural

measures and levee alignments. A third plan (Alternative D) consists of a levee and flood wall alignment. A no-action plan is the basis to compare benefits and environmental impacts.

Alternative C is the Tentatively Selected Plan. It is an 18.27-mile levee around Montz, Laplace, Reserve and Garyville, reducing risk to over 7,000 structures. Additionally, four miles of I-10 flooded during Hurricane Isaac is within the proposed system. The plan includes non-structural measures for 1,571 structures in Gramercy, Lutcher and Grand Point. The estimated cost is $881,000,000 and annualized net benefits are $23,000,000 with a benefit to cost ratio of 1.63.

Over the next few months a public comment period will be conducted along with technical, peer and policy reviews. Additional feasibility work remains to be completed on engineering, cost estimating, environmental, economic, real estate and construction elements of the plan. Results of the reviews and additional feasibility work will be incorporated into a final report. The final report will be made available for state and agency and public review before the Chief of Engineers makes a final recommendation on the project.

Hurricane Isaac flooding at I-10 and US-51.

Appendices

List of Tables

List of Figures

1.0 INTRODUCTION

The U.S. Army Corps of Engineers (USACE) Mississippi Valley Division (MVD), New Orleans District (CEMVN) prepared this feasibility report and Environmental Impact Statement (EIS) for the West Shore Lake Pontchartrain (WSLP) Hurricane and Storm Damage Risk Reduction study. It includes input from the non-Federal study sponsor, natural resource agencies, and the public. This report presents potential solutions to reduce hurricane storm surge damages in St. Charles, St. John the Baptist and St. James Parishes, Louisiana. The study website is http://www.mvn.usace.army.mil/About/Projects/WestShoreLakePontchartrain.

1.1 Background

The study area (Figure 1-1) is located in southeast Louisiana between the Mississippi River, and Lakes Maurepas and Pontchartrain. The towns of Montz, Laplace, Reserve, Lutcher, Gramercy, Grand Point, Convent, Garyville and Romeville are area communities. The 184,351 study acre area occupies a portion of one of the oldest delta complexes in the Mississippi River Deltaic Plain. It is located in the lower Mississippi River alluvial plain in the Pontchartrain Basin. The area includes residential and commercial developments south of Interstate 10 (I-10). West of Laplace, a majority of the developed areas are found between U.S. Highway 61 (US-61) and the Mississippi River levee. The area north of I-10 comprises the State of Louisiana's Maurepas Swamp Wildlife Management Area (WMA). The project area includes lands potentially impacted by the proposed action.

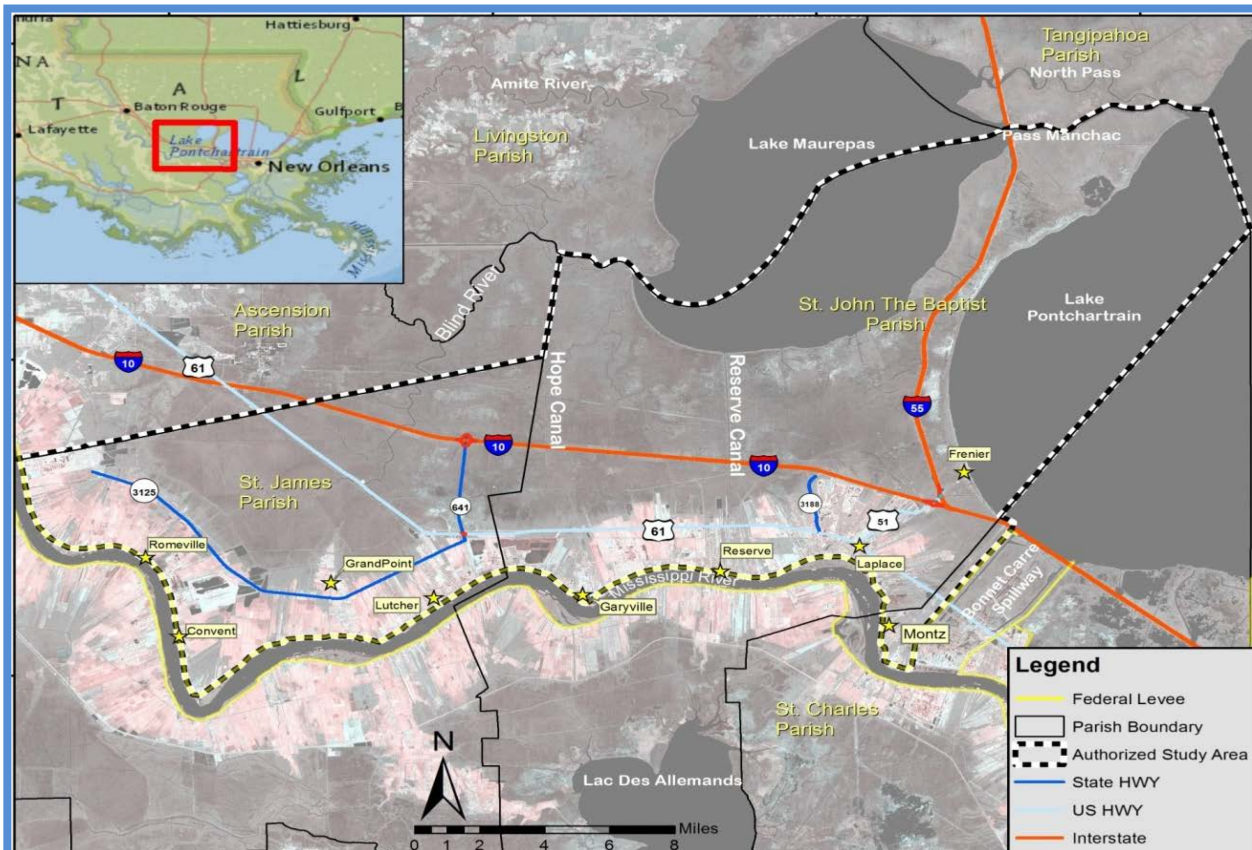


Figure 1-1: West Shore Lake Pontchartrain authorized study area.

Hurricane or tropical storm winds push on the ocean's surface, causing a rise of water over and above the predicted tide. This is called storm surge. Hurricanes and tropical storms are an important part of Louisiana's history and culture. The region experiences tropical waves,

depressions, storms and hurricanes. The study area is highly susceptible to storm surge. The destruction caused by a 1915 hurricane was recounted years later:

> *"… an enormous storm surge advanced with great rapidity upon the western shore of Lake Pontchartrain well ahead of the eye of the hurricane which very nearly struck Frenier head on. As the storm came ashore in the New Orleans area, fifty people drowned as a thirteen foot storm surge swept the Rigolets railroad bridge away. It should also be emphasized that damage and destruction to homes and property were occurring even as the eye of the hurricane was 165 miles from Frenier. Two-hundred seventy-five Louisianians lost their lives as a result of the "Great West Indian Hurricane of 1915."* (Landry 1996)

Recent hurricanes impacting the area include Katrina and Rita in 2005, Gustav and Ike in 2008, and Isaac in 2012. These storms threatened a region that plays a vital national economic role and that serves as a key transportation corridor.

An important swamp buffer separating development from nearby lakes has been impacted over time. The closure of bayous and the construction of levees cut off the annual flooding that historically nourished and maintained the cypress/tupelo habitat in the Maurepas Swamp. The cypress forests of the swamp were logged in the 1890s – 1930s. Canals and railroads were built through the swamp to remove cut timber (Figure 1-2). The swamp is converting to fragmented marsh and open water (USACE 2010a, USACE 2010b). The area may experience up to 2.32-feet of relative sea level rise (RSLR) over the next 50-years under an "intermediate" scenario. The surge buffer benefits of the swamp will continue to diminish as it degrades and disappears and as sea level rises.

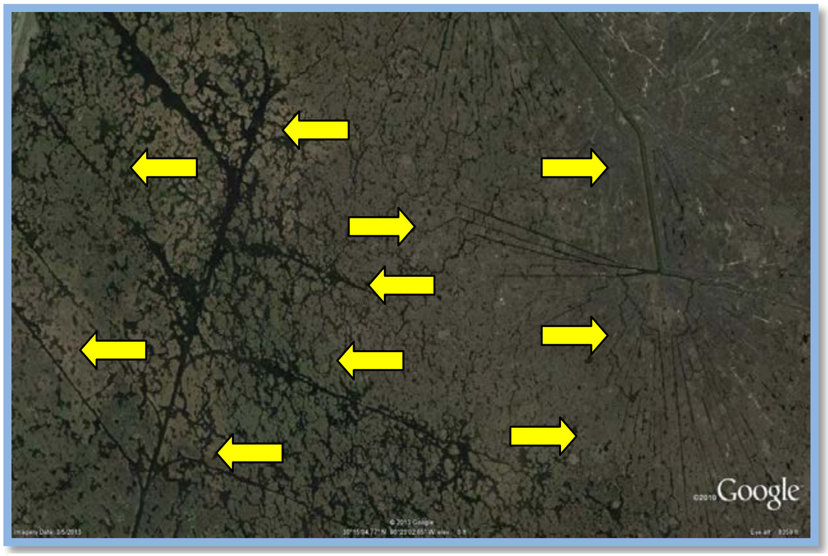


Figure 1-2: Old logging canals in Maurepas Swamp.

1.2 Purpose, Scope, and Need for the Study (*National Environmental Policy Act Required)

The study purpose is to provide a recommendation for Federal participation in hurricane storm damage risk reduction for St. Charles, St. John the Baptist and St. James Parishes that would be economically and environmentally justified. The study addresses flooding caused by storm surge but does not address rainfall flooding. There have been significant changes over the last 40 years, especially since Hurricane Katrina. Population has grown over the past few decades. This report presents a collaboratively-developed plan prepared in accordance with the National Environmental Policy Act (NEPA) and Engineering Regulation 1105-2-100, the USACE Planning Guidance Notebook. It consists of a main report and appendices, and identifies the expected benefits, estimated cost and implementation responsibilities for a tentatively selected plan (TSP). The report provides an overview of the study and summarizes detailed information found in technical appendices. The report is an interim response to the study authority.

1.3 Problems, Needs and Opportunities

Problems in the Study Area

1. Storm surge flooding of approximately 7,698 structures (6-8 feet in areas).
2. Hurricane evacuation routes become impassable and receive damages during storm surges.
3. Agricultural losses resulting from prolonged periods of standing water (e.g., inability to drain saltwater).

Storm surge flooding damages homes, businesses and infrastructure. Surge travels from the Gulf of Mexico into the basin and floods the three study area parishes and beyond (Figure 1-3). Since 1855, 70 hurricanes have made landfall within 65 nautical miles of Laplace (Figure 1-4). Hurricanes Betsy (1965), Camille (1969), Juan (1985), Andrew (1992), Katrina and Rita (2005), Gustav and Ike (2008), and Isaac (2012) caused storm surge flooding. Hurricane Isaac's surge, measured from 6 to 8 feet in the area, threatened lives and damaged more than 7,000 homes, closed roads and disrupted the Nationally-significant energy industry (Figure 1-5).

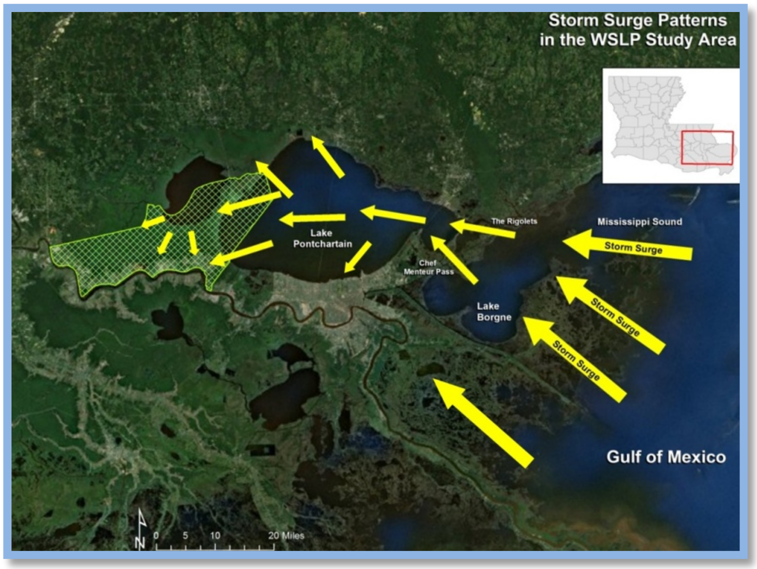


Figure 1-3: Area storm surge patterns.

Businesses and workers serving the Port of South Louisiana are located in the area. The port is the largest volume port in the Western Hemisphere and the ninth largest in the world. It stretches 54 miles on the Mississippi River between New Orleans and Baton Rouge. Hurricane Isaac disrupted port logistics. Its storm surge blocked facility access closing the port. Oil refineries, including the Nation's third largest, were shut down. Gasoline production stopped. Regional and National fuel prices spiked. The storm caused extensive agricultural losses due to an inability to drain storm surge water from fields.

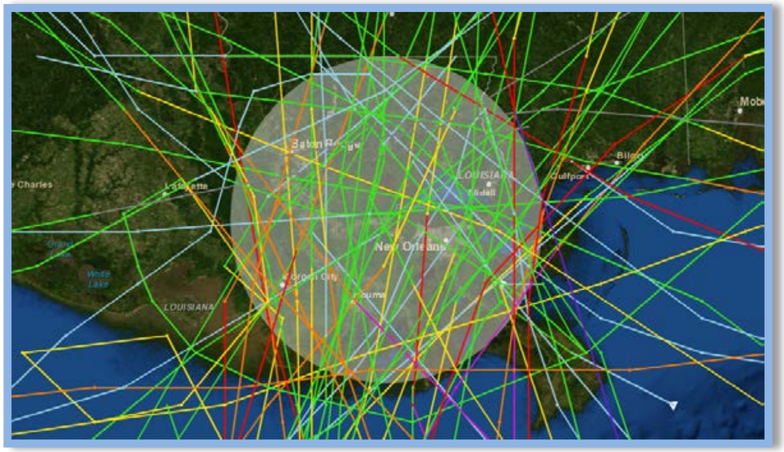


Figure 1-4: Hurricane tracks within 65 nautical miles of Laplace, Louisiana (NOAA 2013).

The study area setting offers a bounty of natural resources but it was historically subject to flooding from the river and nearby lakes. Levees were constructed along the Mississippi River starting in the 1700s to combat annual floods. These levees allowed settlement of the area and agricultural production and the harvesting of natural resources. The area remains susceptible to floods from tropical storms and hurricanes. Some natural protection is afforded by a large cypress swamp that


Figure 1-5: Hurricane Isaac flooding in Laplace, Louisiana.

separates developed areas from nearby tidal lakes. The swamp has degraded over time and the buffer it provides between the lakes and towns is decreasing. As a result, flooding from storm surge (Figure 1-3) remains a risk that is expected to increase over time. The management of Mississippi River flood risk, and the accompanying development of interior drainage systems, allowed urban and suburban expansion in much of the region beyond the natural high-ground near the Mississippi River. Population has increased with suburban development between Baton Rouge and New Orleans. Residents are attracted to the area because of employment opportunities, quality of life, and access to recreation. These factors, increasing population and degrading natural buffers, combine to increase storm surge flooding risks.

1.4 Need for Action

The U.S. Congress recognized the need for a hurricane and storm damage risk reduction project in the area. Two Congressional resolutions authorize this study. The first was adopted on July 29, 1971 by the U.S. House of Representatives Committee on Public Works.

> *"RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE HOUSE OF REPRESENTATIVES, UNITED STATES, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report of the Chief of Engineers on Lake Pontchartrain and Vicinity, Louisiana, published as House Document No. 231, 89th Congress, First Session, and other pertinent reports, with a view to determining whether modifications to the recommendations contained therein are advisable at this time, with particular reference to providing additional levees for hurricane protection and flood control in St. John the Baptist Parish and that part of St. Charles Parish west of the Bonnet Carré Spillway."*

The U.S. Senate Committee on Public Works adopted a resolution on September 20, 1974.

> *"RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, that the Board for Rivers and Harbors is hereby requested to review the report of the Chief of Engineers on Lake Pontchartrain and Vicinity, Louisiana, published as House Document No. 231, 89th Congress, First Session, and other pertinent reports, with a view to determining whether modifications to the recommendations contained therein are advisable at this time, for hurricane protection and flood control in St. James Parish."*

The study was first funded in the 1980s. A 1985 Reconnaissance Report found that there was no justified structural plan suitable for Federal participation. A 1987 reconnaissance report indicated that under Federal criteria a solution could not be found that would be economically justified or environmentally acceptable. Because of increasing population and economic activity, a 1997 reconnaissance report indicated that the study should proceed into feasibility phase. A Feasibility Cost Share Agreement was executed with the Pontchartrain Levee District (PLD) in 1998. The study stopped in 2002. Following Hurricane Katrina, renewed interest by the levee district led to an amended agreement in 2008. Planning for the project was underway when Hurricane Isaac hit in August 2012. President Obama traveled to Laplace, Louisiana after the storm to view the damage and visit with residents and local leaders (Figure 1-6). The President said, **"*We're getting on the case to figure out what happened here and what we can do to make sure it won't happen again.*"** The USACE's post-Isaac damage assessment met the first part of the President's commitment. This study will help deliver the second part.

Figure 1-6: President Obama in Laplace following Hurricane Isaac, September 3, 2012. (Getty Images)

1.5 Objectives of Action

Identifying problems, needs, opportunities, and objectives ensures unity of purpose throughout the planning process. Solving problems and taking advantage of these opportunities provides a basis for effective solutions. **Critical needs** were identified based on the problems.

Critical Needs in the Study Area

1. Keep hurricane evacuation routes open before and after storms.
2. Reduce property damage.
3. Inform public of increased risk of living in flood prone areas.

Opportunities to solve problems were identified based on these needs.

Study Opportunities

1. Reduce hurricane flood risks and damages.
2. Provide smart growth education.
3. Educate local planners and public officials on potential future stages (e.g. 2070).
4. Improve flood warnings for preparation and/or evacuation.
5. Develop measures to reduce damages to evacuation routes due to storm surge.
6. Recommend future modifications to the roadway systems.
7. Develop measures to reduce the flood risk to agricultural areas.
8. Modify connection between lakes and developed areas.

A **study goal** based on the problems, needs and opportunities was developed to help create and evaluate alternative plans. It is the overarching intent of the project.

Study Goal
Reduce the risk of storm surge damages.

A **planning objective** states the intended purposes of the planning process. It is a statement of what solutions should try to achieve. Objectives provide a clear statement of the study purpose.

Planning Objectives

1. Reduce hurricane storm surge related damages through 2070.
2. Reduce risk to residents' life and health by decreasing flooding to the maximum extent practical.
3. Increase public awareness of hurricane risks in developed flood prone areas.
4. Enhance public awareness of the risk to life and property of development in flood prone areas.
5. Reduce the risk of damage and loss of critical infrastructure, specifically the I-10/I-55 hurricane evacuation routes.

1.6 USACE Civil Works Guidance and Initiatives

USACE planning is grounded in the 1983 Economic and Environmental Principles and Guidelines for Water and Related Land Implementation Studies (Principles and Guidelines). The Principles and Guidelines provide for the formulation of reasonable plans responsive to National, state and local concerns. Within the framework of the Principles and Guidelines, the USACE seeks to balance economic development and environmental needs as it addresses water resources problems. The Federal objective of water and related land resources planning is to contribute to National Economic Development (NED) consistent with protecting the Nation's environment, in accordance with National environmental laws, Executive Orders and other Federal planning requirements. The Planning Guidance Notebook provides the overall direction to formulate, evaluate and select projects for implementation. The study conforms to the USACE Campaign Plan goals and the USACE Environmental Operating Principles.

NEPA is the Nation's charter legislation for protecting of the environment. The Federal regulations for implementing NEPA are found in Title 40 Code of Federal Regulations (CFR) Parts 1500-1508. The intent of NEPA is to ensure that information is made available to public officials and citizens regarding major actions taken by Federal agencies, and to identify and consider concerns and issues from the public. "*Any environmental document in compliance with NEPA may be combined with any other agency document to reduce duplication and paperwork*" (40 CFR §1506.4). This document integrates discussions that normally would appear in an EIS into the feasibility report. Sections in this report include NEPA-required discussions marked "*(*NEPA Required)*" in both the Table of Contents and within the body of the document to assist readers. Table 1-1 lists the required EIS information and its location in this document.

1.6.1 NEPA Scoping Process

NEPA provides for an early and open process to determine the scope of issues to be addressed and identify the significant issues related to a proposed action. A Notice of Intent to prepare an EIS was published in the Federal Register (Volume 73, No. 235) on December 5, 2008. The scoping period ended on February 16, 2009. Scoping identified concerns and preferences for levees. People are concerned about construction times, wetlands, hurricane evacuation routes and funding. The scoping report is available upon request.

Table 1-1: NEPA-required information in this report.

EIS Requirement	Location in this Document
Cover sheet	Cover page
Summary	Executive Summary
Table of Contents	Table of Contents
Purpose of and Need for Action	Chapter 1
Alternatives Including Proposed Action	Chapter 3
Affected Environment	Chapter 2
Environmental Consequences	Chapter 4
List of Preparers	Chapter 9
List of Report Recipients	Chapter 7
Index	Appendix F
Appendices	Listed in the Table of Contents

1.7 Non-Federal Sponsors

The Pontchartrain Levee District is the study non-Federal sponsor (NFS). The Louisiana Coastal Protection and Restoration Authority Board (CPRAB) is the NFS for construction, and for operations, maintenance, repair, rehabilitation, and replacement (OMRR&R).

Figure 1-7: Hurricane Isaac flooding at East St. John High School. (Times-Picayune)

2.0 AFFECTED ENVIRONMENT (*NEPA Required)

This chapter describes the affected environment. The historic and existing conditions and a forecast of the “future without-project” conditions provide the basis for plan formulation. The future without-project condition is the No Action Alternative. Important resources, potentially impacted by the proposed action, and their significance are explained in Appendix A. Topics in this chapter mirror Chapter 4, where the “future with-project” conditions are considered.

Water use, water supply and ground (drinking) water were assessed and determined to not be significantly affected by the proposed action. These resources will not be further discussed in this report. Air quality for the three parish area is in attainment of all National Ambient Air Quality Standards. Consistent with the Louisiana Administrative Code, a general conformity determination is not required and therefore air quality will not be discussed further. The cumulative impact analysis follows the 11-step process described in “Considering Cumulative Effects Under the National Environmental Policy Act” (CEQ 1997).

2.1 General Setting

Climate: The climate is subtropical marine with long humid summers and short moderate winters. The seasonal rainy period occurs from mid-December to mid-March with dry periods in May, October and November. Average annual rainfall is 60 inches with a monthly maximum of 20 inches. The heaviest rainfalls usually occur during the summer, with July being the wettest month averaging 6.42 inches. October is usually the driest month, averaging 3.01 inches of rain.

Physical Features: The geology of the lower Mississippi River alluvial valley and the Louisiana coast is summarized in the LCA Ecosystem Restoration Study (USACE 2004). Lakes Maurepas and Pontchartrain occupy a portion of the old Mississippi River pathway known as the St. Bernard Delta. The complex formed in what was then Pontchartrain Bay, enclosing a portion of it to form Lake Pontchartrain. The St. Bernard delta complex was formed by Mississippi River deposits between 3,000 and 4,000 years ago (Frazier 1967). The majority of other landform features include inland swamp, tidal channels, shallow lakes and bays, natural levee ridges along active and abandoned channels, barrier islands and beaches.

Land Use and Land Loss: The 184,351-acre area contains residential and commercial developments south of I-10. West of Laplace the majority of development is between US-61 and the Mississippi River levee. The area north of I-10 is comprised of undeveloped wetlands in the Maurepas Swamp Wildlife Management Area (WMA). Various land cover classifications from the LCA habitat dataset for calendar year 2000 are presented in Figure 2-1 and Table 2-1.

2.2 Water Environment

Water Stage Duration and Frequency: Normal astronomical tides in Louisiana are diurnal (one high tide and one low tide per day) and can have a spring range of as much as 2 feet. The mean tidal range is approximately 0.51 feet (NOAA 2013a). Amplitudes are influenced by tides, but are generally controlled by meteorological events. East winds drive water into the lake.

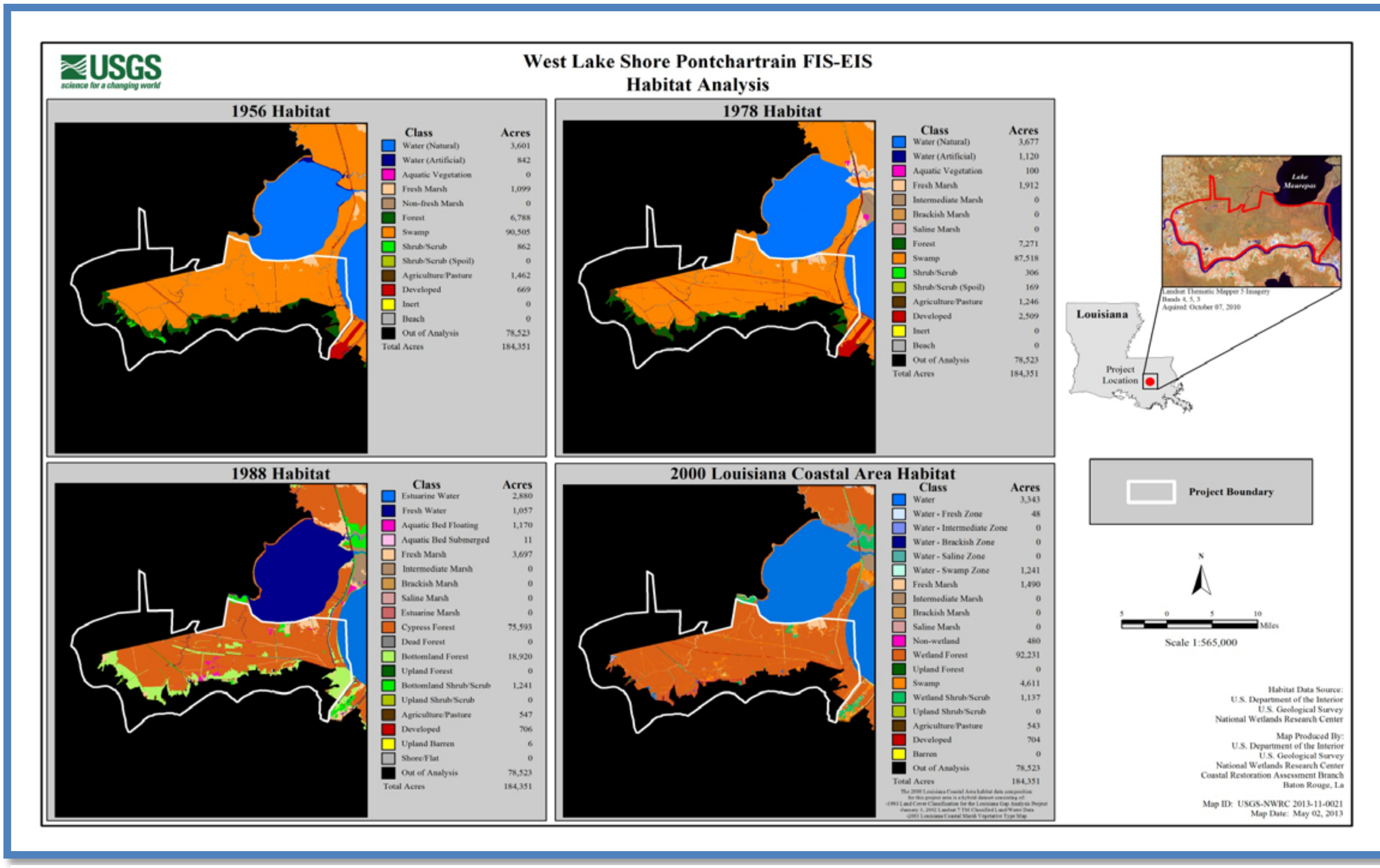


Figure 2-1: Habitats and land loss within the project area.

Table 2-1: Project area land use.

Land Cover Classification	Acres	Percent of Project area
Water	3,343	1.8
Water – Fresh Zone	48	0.02
Water – Swamp Zone	1,241	0.67
Water – Fresh Marsh	1,490	0.80
Non-Wetlands	480	0.26
Wetland Forest	92,231	50.03
Swamp	4,611	2.50
Wetland Shrub/Scrub	1,137	0.62
Agriculture/Pasture	543	0.29
Developed	704	0.38
*Out of Analysis	78,523	42.59
TOTAL	**184,351**	

***Out of analysis: areas not classified in original habitat analysis may contain other land cover classification elements. (NWRC 2013)**

Relative Sea Level Rise: Sea level rise (SLR) conditions were modeled. Mesh and grid elevations were not adjusted for subsidence in this analysis. Rather, the predicted subsidence levels were incorporated in the initial water level parameter to capture the combined effects of subsidence and local SLR into a single relative sea level rise (RSLR) value. For the 2020 and

2070 hydrology simulations, unique RSLR values were added to the 2011 initial water surface elevations (WSE) to calculate the initial WSE appropriate for each year and SLR rate. RSLR values were developed. SLR and RSLR data is listed in Table 2-2 and shown in Figure 2-2.

Table 2-2: Relative sea level rise in the project area.

Year and SLR Scenario	SLR (NAVD88 feet)	RSLR (NAVD88 feet)
2020 Low SLR	0.06	0.30
2020 Intermediate SLR	0.10	0.34
2020 High SLR	0.23	0.47
2070 Low SLR	0.33	1.81
2070 Intermediate SLR	0.85	2.32
2070 High SLR	2.47	3.95

2.2.1 Flow and Water Levels

<u>Historic and Existing Conditions</u>

Changes in the Mississippi River have been responsible for changes in the flow and water levels in the area over several geological periods. Processes involved in the formation of the various deltaic lobes controlled both water levels and flow directions. Seasonal flooding of the Mississippi River has contributed to the historic flow and water level characteristics of the area. Large flood events would bring freshwater, sediment and nutrients to the back swamp areas.

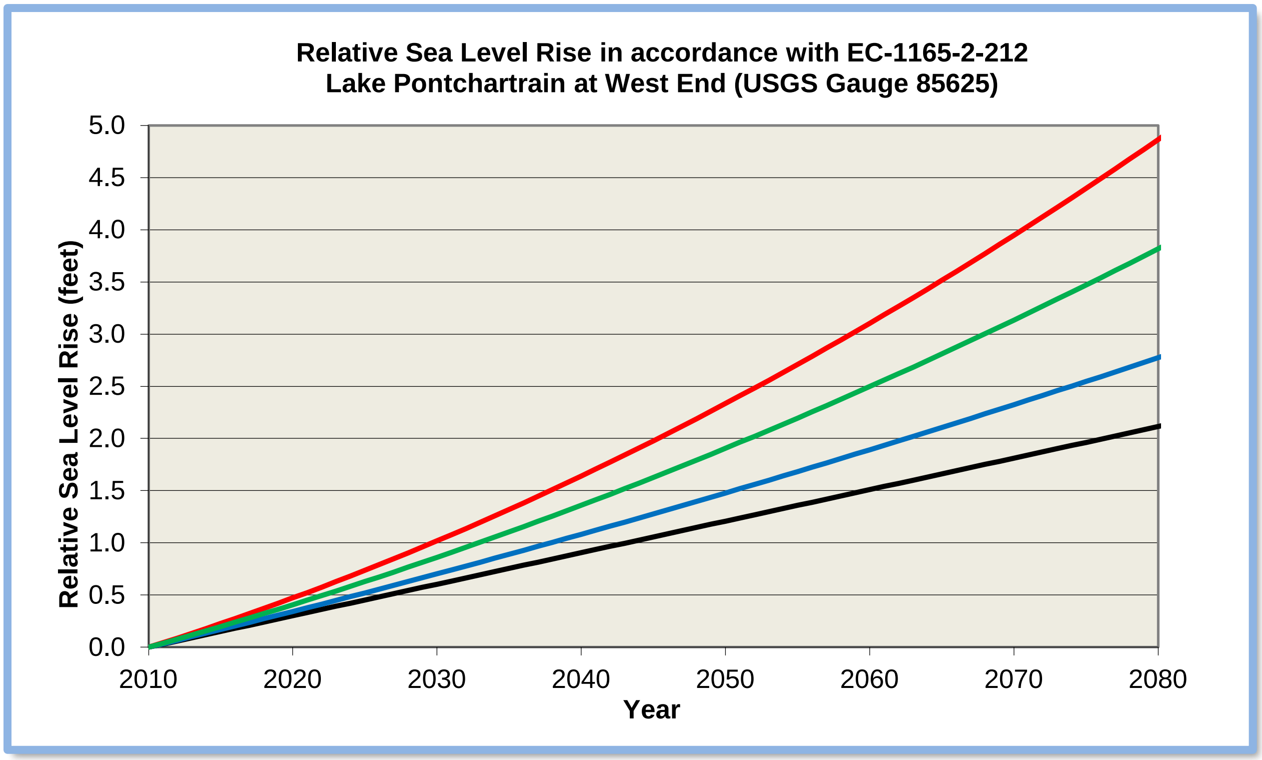


Figure 2-2: Relative sea level rise in the project area. Black = extrapolation of historic rate of RSLR. Blue = low RSLR scenario. Green = intermediate RSLR scenario. Red = high RSLR scenario.

River levees were built in the area beginning in the 1700s by local landowners and governments. Levee building continued through the settlement period and by 1812, the year Louisiana became a state, levees stretched 130 miles upstream from New Orleans to Baton Rouge. The Mississippi River and Tributaries project (MR&T) was authorized by Congress after the Great Mississippi River Flood of 1927. The project provides flood risk reduction for the

Mississippi River and tributaries system from Cape Girardeau, Missouri to the Head of Passes, Louisiana. Levees permanently altered the hydrology of the area by preventing riverine flooding and reducing freshwater inputs to the backwater swamps, Lakes Maurepas and Pontchartrain (USACE 2010). Although the river is no longer directly connected to Lake Maurepas, it is connected to Lake Pontchartrain through the Inner Harbor Navigational Canal and periodic openings of the Bonnet Carré Spillway.

The area's water budget is composed of inflows and outflows through precipitation, evaporation, stream flow, base flow; direct groundwater flow, as well as flows in and out of the estuary. Lake Maurepas is a shallow, fresh to intermediate basin, receiving daily mean freshwater discharge (dmd) primarily from the Amite and Tickfaw Rivers; and to a lesser extent, the Blind River (American Institute of Hydrology, 2006). Lake Pontchartrain is a shallow, brackish basin that receives freshwater discharge from the Tangipahoa, Pearl, and Tchefuncte Rivers, as well as Bayous Lacombe and Liberty, and many smaller creeks.

LCA restoration projects in the study area are closely related and intended to function together to increase freshwater and nutrient inputs to the Maurepas Swamp (USACE 2004). The LCA Convent Blind River Diversion (CBRD) will introduce Mississippi River water to the Maurepas Swamp near Convent, Louisiana (USACE 2010a). The LCA Amite River Diversion Canal (ARDC) would have modified the canal to spread freshwater into the swamp between the Amite River and the Blind River (USACE 2010b). The USACE and State of Louisiana entered into a Design Agreement for Federal implementation of the project. However, in a letter dated August 20, 2012 the State of Louisiana suspended further state participation in Federal design efforts. It is possible that this project would be implemented independently by the State of Louisiana.

The Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) project (PO-29) "River Reintroduction into Maurepas Swamp" project would divert Mississippi River water to the Maurepas Swamp through Hope Canal. Construction of this project was planned to transition under the LCA program as the "Hope Canal Diversion" project. The project is currently not authorized for construction under either the CWPPRA or LCA programs. It could potentially significantly change area hydrology. As part of the WSLP scoping effort, correspondence from CPRA (formerly the OCPR) requested that the features of the CWPPRA project be incorporated into the WSLP study. CPRA's letter emphasized that any storm damage control structure constructed in the area should allow for the exchange of water in the swamp north and south of I-10. Although the CWPPRA project has been in the engineering and design phase the Environmental Protection Agency, as the lead Federal sponsor for the CWPPRA project, has suspended Federal expenditure on this project as a result of plans by the State of Louisiana to independently implement this project. Recently, the State of Louisiana submitted a permit application to construct the project as an independent effort. If this permit is obtained by the State, the project will not be implemented by the programs.

Because of the uncertainty as to the entity that would implement the ARDC and PO-29 diversion projects in the Maurepas Swamp, further references in this report to the ARDC and PO-29 diversions will be collectively to the "Maurepas Swamp Diversions," and will not reference Federal or State responsibility for implementation.

<u>Future Without-Project Conditions (No Action Alternative)</u>

There would be no direct, indirect or cumulative impacts with the No Action Alternative. Existing conditions and future changes to flow and water levels would not change.

2.2.2 Sedimentation and Erosion

Historic and Existing Conditions

The area has one of the highest land subsidence rates in the country, estimated at 0.4 inch annually. The rate is variable along the coast (Battelle 2005). Coastal Louisiana is more prone than other areas to subsidence and land loss. Human actions have exacerbated the problem.

Shoreline erosion along Lake Maurepas, measured by the USGS Coastal and Marine Geology Program since 1899, shows an average shoreline loss between 1899 and 1995 of approximately 39 inches per year (Zganjar et al. 2002). Shoreline erosion may be attributed to storm surges, lack of sediment entering the area, canal construction, logging operations, and wind and waves. In addition, RSLR and associated saltwater influx has caused increased erosion in coastal wetland areas.

Saucier (1963) calculated Lake Pontchartrain shoreline retreat by comparing aerial photographs from 1931 through 1937, with photographs from the 1950 through 1954. The data shows average annual erosion for one-mile stretches of shoreline. The southwestern shoreline retreats at a mean rate of 8.9 feet per year compared to 3.6 feet per year for the north shore and about 5.6 feet per year for the south shore. Saucier attributed shoreline erosion to subsidence, lack of sediment input, increasing fetch and SLR.

The Maurepas swamp, which includes the 103,263-acre Maurepas Swamp WMA, is isolated from Mississippi River fresh water, sediment, and nutrient inputs by levees (LDWF 2005). The only soil building in the swamp is from organic wetland production (Shaffer et al. 2003). Area subsidence is classified as intermediate. When coupled with minimal soil building, net lowering of ground surface elevation results (Shaffer et al. 2003).

The CBRD and the Maurepas Swamp Diversions are intended to sustain this unique swamp system (USACE 2004, 2010a and 2010b). The diversion(s) would increase flow through the southwestern portions of the area, which is intended to provide a constant source of oxygen- and nutrient-rich waters to the swamp. Benefits would include measurable increases in productivity, which could help build swamp substrate and balance subsidence, reduce mortality, and increase soil bulk density. As accretion improves, there could be an increase in recruitment of new cypress and tupelo. Anticipated sediment benefits could include direct contribution to accretion, as well as contribution to biological productivity through the introduction of sediment-associated nutrients, which also could contribute to production of substrate.

Future Without-Project Conditions (No Action Alternative)

There would be no direct, indirect or cumulative impacts. Existing conditions and future changes to sedimentation and erosion in the area would persist as would potential offsets to those losses by restoration impacts from the CBRD and the Maurepas Swamp Diversions. Soil erosion and land loss would continue at the same or increased rates. Natural and man-made levees would continue to subside and organic soils would not be able to maintain their elevations due to subsidence, decreased plant productivity, and wave erosion (USACE 2004). Sediments would continue to be transported from terrestrial areas into Lakes Maurepas and Pontchartrain.

2.2.3 Water Quality and Salinity

Historic and Existing Conditions

Water Quality Influences: Area water quality is influenced by basin elevations, surface water budget, land cover and use, coastal deltaic processes, and regional weather. The study area is in the western portion of the Pontchartrain Basin. The basin is influenced by several rivers which provide freshwater to estuarine lakes connected to each other and, ultimately, to the Gulf of

Mexico via several major passes. The estuary has experienced hydro-modification via the construction of canals and embankments such as road and railroad beds and hurricane storm damage risk reduction features (Keddy et al. 2007, Sikora and Kjerive 1985, Tate et al. 2002). The basin includes upland forest and agricultural land north of the estuary, wetlands and open water in the estuary, development and agriculture along the Mississippi River corridor and in nearby urban areas (Demcheck et al. 2004, Brown et al. 2010, Wu and Xu 2007, Turner et al. 2002, Patil and Deng 2008). Chemical transformations occurring in the estuary can be biologically mediated by wetlands (Mitsch and Gosselink 2000). A diversity of wetland types exist in the estuary which are affected by coastal deltaic processes and anthropogenic factors (Gosselink 1984, Keddy et al. 2007). Weather patterns can affect estuary marine influence, flow direction, water level, and wetlands biogeochemistry (Gosselink 1984). Timing and amount of precipitation can also affect water quality (Demcheck et al. 2004, Keddy et al. 2007).

Literature Review: Development in the basin in the 20th century led to degradation of estuary waters (Hastings 2009). Historical pollution sources include sewage discharges, increased urbanization and farming, mining of water bottoms, and oil and gas activities. While recently many of these sources are curtailed or eliminated, urbanization and farming are increasing (Patil and Deng 2008, Brown et al. 2010, Turner et al. 2002, Wu and Xu 2007). Garrison (1999) provides a water quality summary for data collected in Lake Maurepas from 1943-1995. Sikora and Kjerve (1985) and Tate et al (2002) both compared pre-/post-MRGO salinity trends, finding a 0.2-0.4 PPT increase at Pass Manchac. Patil and Deng (2008) investigated water quality of the Amite River; dissolved oxygen (DO) levels in the river decreased by 1 mg/L between 1975-1990 and 1991-2005. Findings of the study implicate continued mining in the river and increased urbanization of the watershed. Recently, a total maximum daily load (TMDL) for the river for DO was developed (LDEQ 2011). Studies were conducted in support of the diversion of Mississippi River water into the Maurepas Swamps (e.g., Lee Wilson and Associates 2001, Shaffer et al. 2003, Hoeppner et al. 2008, Lane et al. 2003, Shaffer et al. 2009), and discuss water quality, and suggest that diversions may be beneficial during droughts.

Louisiana Water Quality Inventory: Historical (1998-2012) Clean Water Act Section 305(b) assessments of study area sub-segments were evaluated. For each sub-segment, an average designated use support value was calculated (0=always impaired, 1=unimpaired; see Appendix A for methodology and details). Long-term average support values reveal that impairments are commonplace in sub-segments west of the Maurepas land bridge. The most commonly suspected causes included in the 305(b) assessments were non-native aquatic plants; low DO, mercury, fecal coliform, total phosphorus, sedimentation/siltation, and elevated turbidity, while the most commonly suspected sources were unknown sources such as, atmospheric deposition, introduction of non-native organisms, on-site treatment systems, wetland habitat modification, and site clearance for land development/redevelopment. In the current (2012) 305(b) assessment, the most frequently cited suspected causes of impairment include non-native aquatic plants, low DO, mercury, elevated turbidity, and fecal coliform, while most frequently cited suspected sources of impairment include wetland habitat modification, introduction of non-native organisms, atmospheric deposition, unknown sources, on-site treatment systems, natural sources, and agriculture.

Water Quality Monitoring: See Appendix A for water quality details. For each monitoring station in the study area, data for selected parameters was summarized by means of box plots (overall and seasonal), quantile plots, and trend analysis. Findings suggest differences in water quality based on habitat, salinity, and season. Low DO is common in the Maurepas Swamp. Pass Manchac is experiencing increased marine influence.

Future Without-Project Conditions (No Action Alternative)

Direct and Indirect Impacts: There would be no direct impacts. DO and salinity gradient trends are expected to continue. Without a project there would be an increased risk of damage from storm surge resulting from hurricane and tropical storm events in the area. Drainage of storm waters containing elevated nutrients, metals, and organics into water bodies connected to the Maurepas Swamp and Lake Maurepas is a possibility (Farris et al. 2007). Without the proposed project, the area would still be affected by the following:

- Restoration and Other Efforts – the LCA CBRD project (USACE 2010a) has the potential to locally reduce salinity stress and improve DO. Multiple diversion projects throughout the Pontchartrain Basin may concurrently have the potential to generate significant changes in wetlands biogeochemistry, some of which may negatively affect wetland plant community resiliency (Swarzenski et al. 2005).
- Federal and state water quality programs – may address land use practices in the Mississippi River basin and could impact the area water quality (Broussard 2008).
- Coastal processes – the Maurepas Swamp is anticipated to continue to decline and convert to marsh and open water, in turn affecting local water quality conditions.
- Development – development in watersheds affecting the study area.
- Climate change, sea-level and hurricane/tropical storm surge frequency may impact water quality through increased frequency of saltwater intrusion (Mousavi et al. 2011).

2.3 Human Environment (Socioeconomics)

2.3.1 Population and Housing

Historic and Existing Conditions

Table 2-3 shows the population trend in the three-parish area. Population increases between 2000 and 2010 are likely the result of population influx after Hurricane Katrina (2005). The three parish total population in 2010 was 120,806 residents. The 2012 population in the three parishes declined to 119,161 (U.S. Census 2013) due mainly to Hurricane Isaac impacts.

Table 2-3: Parish-wide populations (in 1000s). (U.S. Census 2013)

Parish	1970	1980	1990	2000	2010
St. Charles	29.5	37.5	42.5	48.2	52.8
St. James	19.7	21.6	20.8	21.4	22.1
St. John the Baptist	23.8	32.3	40.1	43.1	45.9
Total	**73.0**	**91.4**	**103.4**	**112.7**	**120.8**

The 2012 study area population totaled 62,900 residents. Housing trends (Table 2-4) parallel population growth. Almost all residential and non-residential development is on the higher ground adjacent to the Mississippi River. Major area communities include: Laplace, the largest urban area in the study; Reserve and Garyville in St. John the Baptist Parish; Gramercy and Lutcher in St. James Parish; and Montz in St. Charles Parish. The area was most recently flooded by Hurricane Isaac (2012) storm surge (Figure 2-3 and Figure 2-4).

Table 2-4: Number of households in study area (in 1000s). (U.S. Census 2013)

Parish	1970	1980	1990	2000	2010
St. Charles	7.59	11.6	14.4	16.5	17.2
St. James	4.63	6.1	6.4	7.0	6.9
St. John the Baptist	5.77	9.4	12.7	14.3	15.1
Total	**17.99**	**27.1**	**33.5**	**37.8**	**39.2**

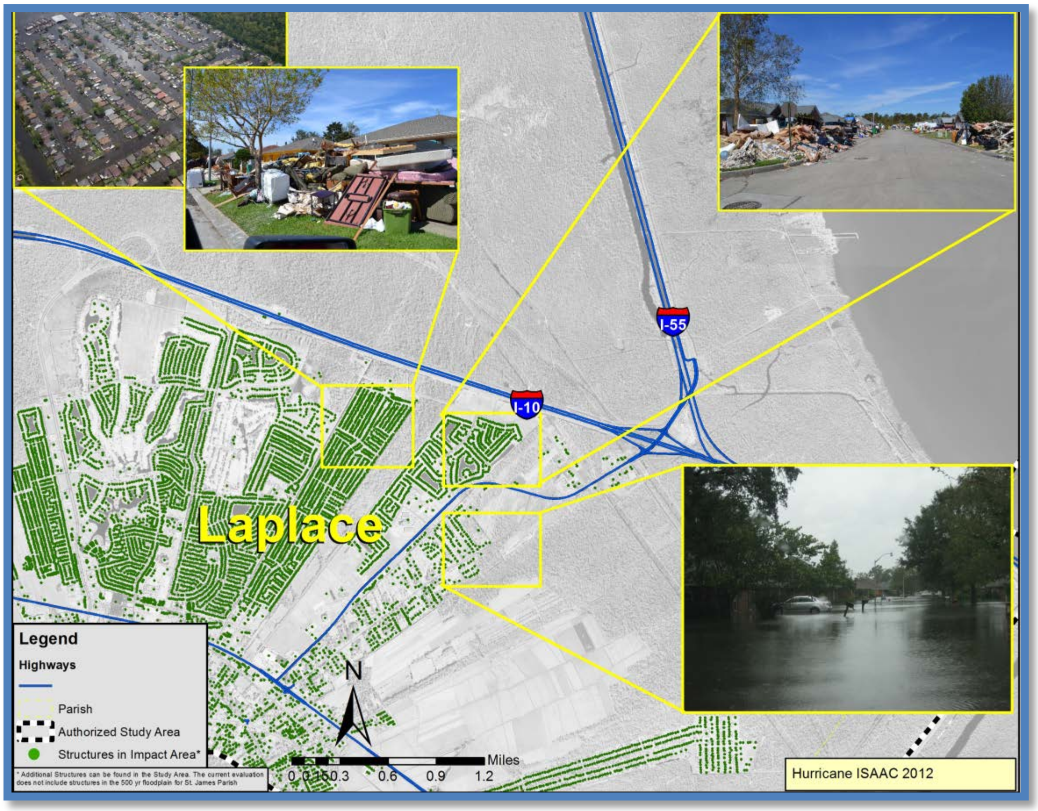


Figure 2-3: Hurricane Isaac storm surge flooding in Laplace.

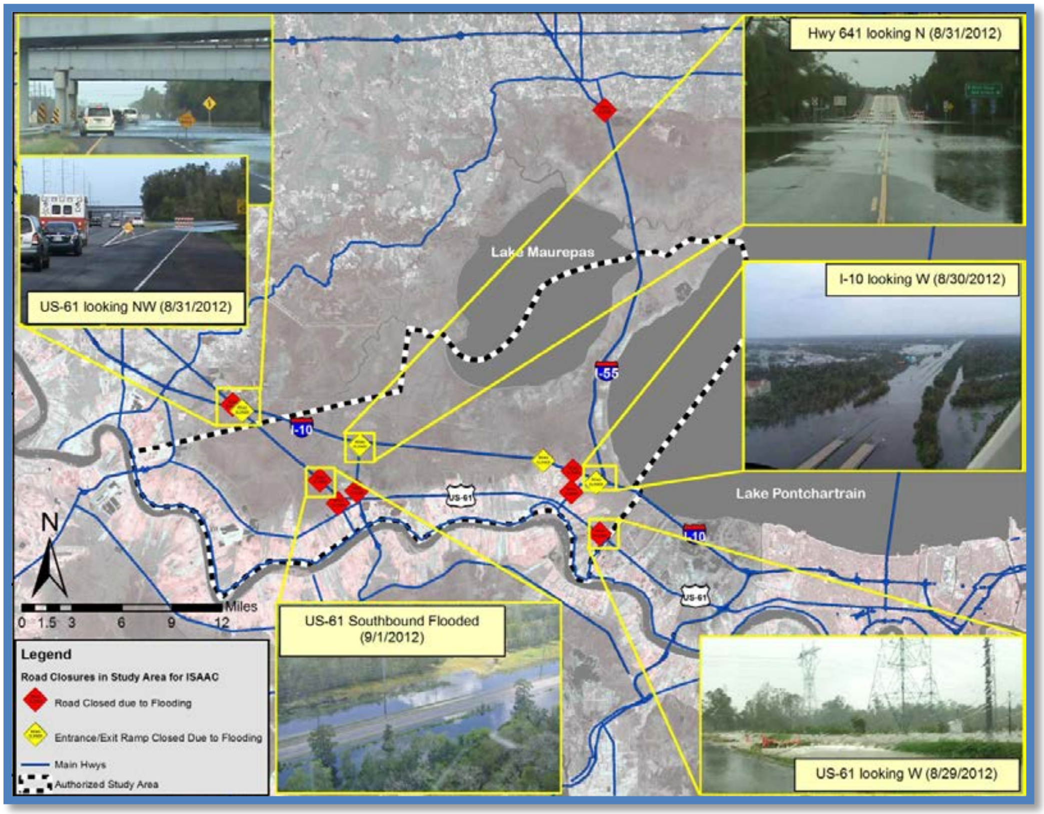


Figure 2-4: Hurricane Isaac storm surge flooding of important transportation routes.

Approximately 20,000 residential structures were inventoried in the study area. Federal Emergency Management Agency (FEMA) data indicates storm surge and rainfall flood claims for the three parishes were paid between 1978 and 2012 totaling $338,000,000 (Table 2-5). Evaluations conducted for the study showed that under the modeled 100-year storm surge conditions approximately 7,689 structures' first floors would potentially be inundated under the existing conditions. First floor elevations were determined via field approximations (Figure 2-5).

Table 2-5: Summary of parish-wide storm damage insurance payments 1978 through 2012. (FEMA 2013)

Parish	# of Claims	Total Nominal Dollar Amount (in millions)	Average Dollar Amount per Claim
St. Charles	5907	$100.13	$16,950
St. James	135	$1.74	$12,870
St. John the Baptist	4851	$236.18	$48,690
Total	**10898**	**$338.05**	**$31,030**

<u>Future Without-Project Conditions (No Action Alternative)</u>
Population and housing are expected to follow economic trends in the local, regional, and National economies. An increase of 33,000 residents and approximately 11,000 residential structures are projected. In the absence of hurricane/tropical storm surge damage risk management measures population and housing could be adversely affected.

Evaluations of the future without-project conditions showed that under the modeled 100-year storm surge conditions 14,486 structures' first floors would potentially be inundated under the 2070 intermediate sea level rise conditions (Figure 2-6). One or a series of catastrophic hurricane/tropical storm surge events would result in severe negative impacts to residents and cause significant damage to structures. Additionally, residents in these communities could potentially incur higher insurance premiums offered by the National Flood Insurance Program (NFIP) should insurance rate maps (FIRM) be updated to reflect an increase in storm damage risk over time.

Direct and Indirect Impacts: The No Action Alternative would have no direct impacts. Indirect impacts would include a higher potential for permanent displacement of population compared to the proposed alternative as residents relocate to areas with less risk.

2.3.2 Employment, Business, and Industrial Activity (including Agriculture)

<u>Historic and Existing Conditions</u>
Table 2-6 shows the growth of non-farm employment in the three-parish-wide area. Increase in employment is likely the result of the influx of population and businesses after Hurricane Katrina (2005). Leading employment sectors include education, health care and social assistance, manufacturing, and retail. Approximately 1,900 non-residential structures are in the area including: petroleum services and river services companies, Zapp's Potato Chip Factory and the Marathon refinery. Approximately 10 percent of the area (23,800 acres) is devoted to agriculture, and about half of these acres are sugar cane crops. This percentage differs from land use percentages described in Table 2-1, which indicates only 543 acres are in agriculture. This apparent discrepancy is because the data was developed for land loss comparisons in the LCA (2004) study; land uses in over 40 percent of the study area were not included.

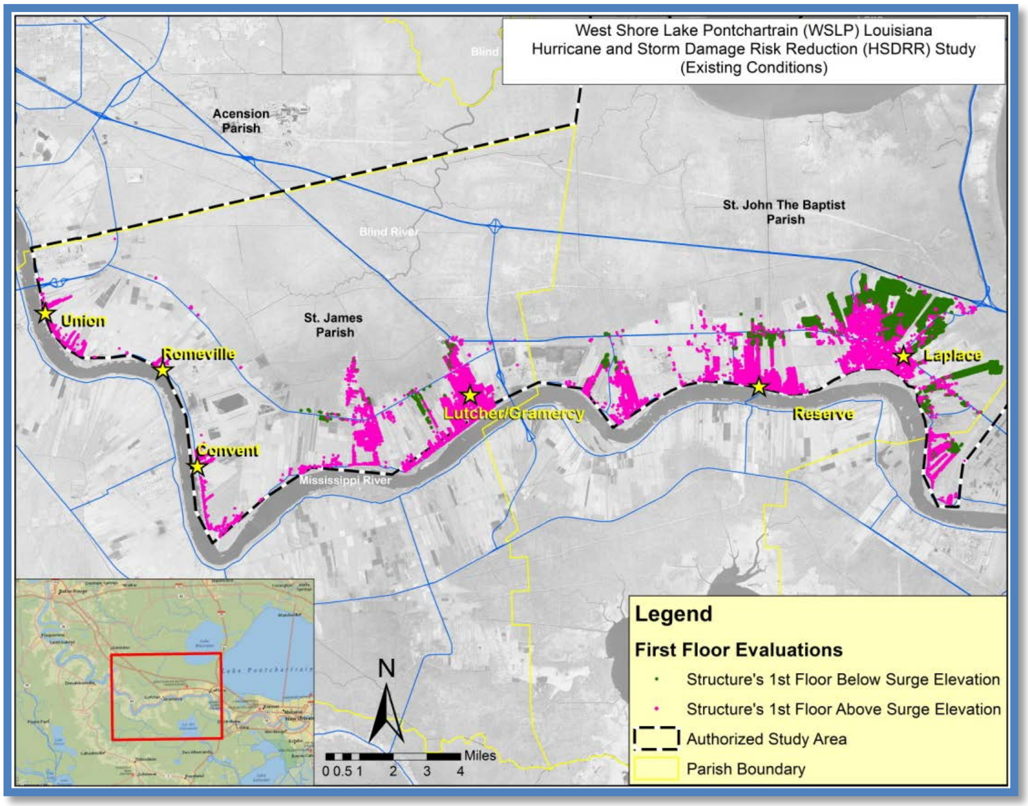


Figure 2-5: First floor evaluations (existing conditions).

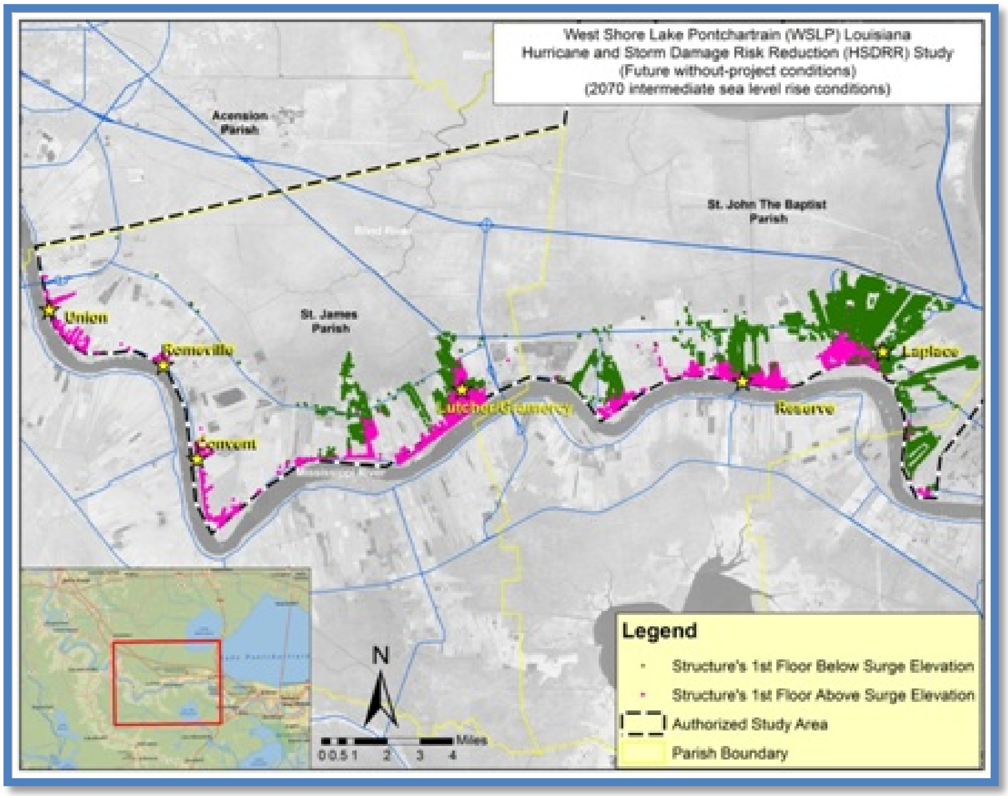


Figure 2-6: First floor evaluations (future without-project conditions).

Table 2-6: Historical parish-wide non-farm employment (in 1000s). (Moody's 2013)

Parish	1970	1980	1990	2000	2010
St. Charles	9.0	18.1	18.5	20.1	24.3
St. John the Baptist	5.4	9.8	9.4	7.6	8.1
St. James	4.2	9.4	11.0	13.4	15.0
Total	**18.5**	**37.2**	**39.0**	**41.1**	**47.4**

Future Without-Project Conditions (No Action Alternative)
Growth in employment, business and industrial activity is expected to follow economic trends in the local, regional, and National economies. An additional 22,790 jobs are projected by the year 2080. However, without flood risk management alternatives, the stability of employment, business and industrial activity could be adversely affected. One or more catastrophic hurricane/tropical storm surge events could result in severe negative impacts to employment and business activity and cause significant damage to non-residential structures. Additionally, business owners in these communities could potentially incur higher flood insurance premiums should the FIRMs be updated to reflect an increase in flood risk over time.

Direct and Indirect Impacts: The No Action Alternative would have no direct impacts. Indirect impacts would include a higher potential for temporary interruption or permanent displacement of employment, business, and industrial activity as businesses temporarily or permanently relocate to areas with less storm damage risk.

2.3.3 Public Facilities and Services

Historic and Existing Conditions
Public facilities and services have historically grown to meet population demands. The area includes a mixture of community centers, schools, hospitals, police, and fire protection. An airport, technical college, and facilities associated with the Port of South Louisiana are located in the area. During the threat of hurricanes and severe storms public buildings are occasionally used for shelter. A total of 402 public and quasi-public buildings were inventoried to calculate damages in the three-parish area in 2012.

Future Without-Project Conditions (No Action Alternative)
Public facilities and services are expected to grow with the needs of the population and would follow growth trends. In addition to the 402 public and quasi-public buildings, an additional 165 such facilities are projected by 2070. These facilities would be more susceptible to damages resulting from hurricane/tropical storm surge events. The increased risk of damage to public facilities and the resulting temporary and/or permanent relocation of these facilities would have a negative impact on services.

Direct and Indirect Impacts: There would be no direct impacts. Indirect impacts would include a greater potential for permanent displacement of public facilities and services due to hurricane/tropical storm surge events.

2.3.4 Transportation

Historic and Existing Conditions
Transportation infrastructure includes major roads and navigable waterways that have developed historically to meet the needs of the public. I-10, an east-west route connecting New Orleans and Baton Rouge, crosses the northern part of the area and is a primary hurricane evacuation route. US-61, another evacuation route through the project area, is located south of I-10 and is the northern boundary of the local industrial sector in the area. Most of I-10 and US-61 are either just below or just above the 100-year floodplain. Other major highways in the

project area include I-55, which runs north-south and intersects I-10 in the northeastern portion of Laplace; US-44, which is located in the southern portion of the project area and runs parallel to the Mississippi River; and US-51, which runs north-south through Laplace and parallels I-55.

Other modes of transportation in the project area include water transport along the Mississippi River via vessels and barges, rail, and aviation via the St. John the Baptist Parish airport. Of the three railroads in the project area, two are owned by Canadian National Railroad and one is owned by Kansas City Southern Railroad.

During Hurricanes Ike and Isaac portions of US-61, I-10, and the I-10/I-55 interchange were inundated by a combination of storm surge and rainfall (Table 2-7). This interfered with emergency service access and prevented local and regional residents from returning to their primary residence. This delay in re-population equates to higher emergency costs during storm events, due to the longer time periods required for sheltering residents until the area is made safe to return. There is also the added travel time and cost for taking alternative routes during re-population following tropical storm events.

Travel from Baton Rouge to New Orleans typical takes approximately 1.5 hours without traffic delays. If access routes are congested this extends to two hours (Table 2-8). Most of the alternative routes are on local roads. Traffic congestion on local roads could extend travel time.

Table 2-7: Mean height (elevation) of major hurricane evacuation routes.

Highway Reach	Mean Height (ft. NAVD 88)	Length (miles)	Type
I-10 Laplace Area	**5.42**	**3.76**	**4 lanes divided**
I-10 Reserve Canal Underpass to Mississippi Bayou	7.58	0.88	4 lanes divided
I-10 Mississippi Bayou to Hope Canal	7.91	3.39	4 lanes divided
I-10 Hope Canal to Gramercy Exit	8.28	2.30	4 lanes divided
I-10 Gramercy to Blind River	7.66	1.80	4 lanes divided
I-10 Blind River to Bayou Conway	7.64	2.53	4 lanes divided
US-61 Last Reach	**5.65**	**0.65**	**4 lanes divided**
US-61 Last Reach to Pipeline	5.78	1.55	4 lanes divided
US-61 Pipeline to Boatclub	5.72	1.84	4 lanes divided
US-61 Boatclub to Canal	6.14	0.98	4 lanes divided
US-61 Low area	**5.51**	**1.12**	**4 lanes divided**
US-61 Low area to Gramercy	6.15	0.21	4 lanes divided
US-61 Gramercy Exit	**6.28**	**3.21**	**2 lanes**

*Reaches shown in **bold** flooded during Hurricane Isaac.

Future Without-Project Conditions (No Action Alternative)

Transportation infrastructure would be more susceptible to damages resulting from hurricane/tropical storm surge events. There would be an increased risk that access to infrastructure would be reduced due to storm surge.

Direct and Indirect Impacts: With no action there would be no direct impacts. Indirect impacts would include a higher potential for damages to transportation infrastructure in the area as a result of hurricane/tropical storm surge events, coupled with the interruption of use by emergency responders and residents.

Table 2-8: Potential transportation impacts.

Scenario	Typical Travel Distance between BR and NOLA	Average Travel Time* between BR and NOLA	Additional Travel Distance from Scenario # 1	Average Additional Travel Time from Scenario # 1	Comments
Scenario #1: No Impacts	83.90 miles	1.43 hours	-	-	-
No access to I-10	96.30 miles	1.70 hours	12.40 miles	16 mins	No exit to Laplace Area
I-10 impacted between Laplace and Belle Terre exits	87.50 miles	1.60 hours	3.60 miles	10 mins	4 lane local highway ~ 13 stop lights
I-10 impacted between Gramercy/Lutcher and Belle Terre exits	88.60 miles	1.67 hours	4.70 miles	14 mins	4 lane local highway ~ 19 stop lights
I-10 impacted between Sorrento and Gramercy/Lutcher exits	89.90 miles	1.63 hours	6.00 miles	12 mins	4 lane local highway ~ 20 stop lights
I-10 and US-61 impacted thru Maurepas Swamp	91.70 miles	1.83 hours	7.80 miles	24 mins	2 lane local roadway >20 stop lights

*__BR__ = Baton Rouge. **NOLA** = New Orleans; travel times are based on number of lanes, distances and speed limits. Road conditions (e.g. traffic density) were not factored into calculations.

2.3.5 Community and Regional Growth

Historic and Existing Conditions

Community and regional growth are influenced by National trends, but depend significantly upon local attributes. Table 2-9 shows per capita income growth since 2000 in the area. Growth has been aided by the flood risk reduction provided by the MR&T levee system.

Table 2-9: Parish-wide per capita income. (U.S. Census 2013 and Moody's 2013)

Parish	1990	2000	2010	2012
St. Charles	$17,297	$24,228	$32,599	$34,992
St. John the Baptist	$14,231	$18,327	$29,663	$31,492
St. James	$14,440	$19,720	$29,351	$31,349

Future Without-Project Conditions (No Action Alternative)

Risk reduction from hurricane/tropical storm surges would not be provided for communities in the project area. Property owners in these communities could potentially incur higher flood insurance premiums should FIRMs be updated to reflect an increase over time in the risk of damage from hurricane/tropical storm surge events. While community and regional growth is expected to follow National and local economic trends, increased insurance premiums associated with damage resulting from hurricane/tropical storm surge events could have a negative impact on community and regional growth relative to areas with lower flood insurance premiums.

Direct and Indirect Impacts: With no action there would be no direct impact. Indirect impacts under the No Action Alternative would include a higher potential for less community and regional growth due to increasing risk of damage from hurricane/tropical storm surge events.

2.3.6 Tax Revenues and Property Values

Historic and Existing Conditions

Damages from hurricane/tropical storm surge events can significantly impact business, industries, farms, property values, local employment and income, which then negatively impacts the tax base created by these activities. Reduction in the risk of damages from hurricane/tropical storm surge events can have a commensurate positive impact on tax revenues and property values. Conversely, the lack of reduction of risk of damages from hurricane/tropical storm surge events in areas highly susceptible to these damages could limit the growth of tax revenues and property values.

Residential (19,958) and non-residential (1,882) structures were inventoried to calculate potential storm-related damages. The median value of owner-occupied housing units are $175,200 in St. Charles Parish, $114,000 in St. James Parish, and $148,800 in St. John the Baptist Parish. Future losses to these properties will tend to reduce tax revenues.

Future Without-Project Conditions (No Action Alternative)

Growth in tax revenues and property values are expected to follow local, regional and National economic trends. However, without storm surge damage risk reduction management measures, the economic stability, tax revenues and property values could be adversely affected. Community residents could incur higher storm damage flood insurance premiums should FIRMs be updated to reflect an increase over time in the risk of damage from hurricane/tropical storm surge events. Higher insurance premiums could negatively affect property values.

Direct and Indirect Impacts: There would be no direct impacts under the No Action Alternative. Indirect impacts could include lower tax revenues as property values decline due to high risk of damage from storm surge events and residents and businesses relocate to lower-risk areas.

2.3.7 Community Cohesion

Historic and Existing Conditions

Community cohesion is based on the characteristics that keep the members of the group together long enough to establish meaningful interactions, common institutions, and agreed upon ways of behavior. These characteristics include race, education, income, ethnicity, religion, language, and mutual economic and social benefits. The project area, which was originally settled in the 1700s, is comprised of communities with established public and social institutions including places of worship, schools, and community interaction.

The construction of water resource projects can impact community cohesion in different ways. For example, prior to the Great Flood of 1927, the area was subject to periodic riverine flood damage events from the Mississippi River. However, with the construction of the MR&T levee system, the risk of inundation from the river has been greatly reduced and the community cohesion of the area was positively impacted.

The area remains highly susceptible to storm surge damage. In August 2012, communities in St. John the Baptist Parish, including the town of Laplace, were inundated by the storm surge from Hurricane Isaac. The study area does not currently have a hurricane or storm surge damage risk reduction system in place. Hence, following Hurricane Isaac, local populations where temporarily forced to relocate thereby disrupting community cohesion.

Future Without-Project Conditions (No Action Alternative)

The area will become more susceptible to damage caused by hurricane/tropical storm surge events that is projected to increase over the period of analysis. The increased risk of damage to residential and non-residential structures and the resulting temporary and/or permanent relocation of populations would negatively affect the community cohesion in many communities.

Direct and Indirect Impacts: There would be no direct impacts. Indirect impacts would include a higher potential for a reduction in community cohesion if the civic infrastructure in the area continues to be damaged as a result of hurricane/tropical storm surge events. Community cohesion may be reduced if residents and businesses relocate to lower-risk areas.

2.3.8 Environmental Justice

Analysis of Environmental Justice (EJ) used census tracts and block groups to obtain a more accurate estimate of the demographics in the study area, which primarily falls on the East bank of the Mississippi River. St. James, a portion of St. Charles, and St. John the Baptist Parishes are considered the reference communities of comparison. Overall parish reference demographics were compared to the census tracts and block groups demographics for the following: the towns of Gramercy, Lutcher, Grand Point and Convent in St. James Parish; the town of Montz in St. Charles Parish; and the towns of Laplace, Reserve and Garyville in St. John the Baptist Parish. The potential for EJ concerns arise in instances where the percent minority (50 percent) and/or low-income (20 percent) population in a census tract or block group is greater than those in the reference community (the entire parish). To analyze communities in the project area, the team used 2010 U.S. Census records. Community outreach activities included conducting small neighborhood meetings and circulation of informational flyers. This methodology is consistent with E.O. 12898.

Historic and Existing Conditions: The study area includes residential, commercial, industrial and undeveloped land. The above referenced towns include predominantly minority and/or low-income populations which have received additional outreach efforts per the requirements of E.O. 12898. Tables 2-10, 2-11 and 2-12 show the percent minority and low-income for communities that could be potentially impacted by the proposed action.

Table 2-10: St. James Parish communities percent minority and low income.

	St. James Parish*	Gramercy	Lutcher	Grand Point	Convent
Total Population	22,102	3,613	3,559	2,473	711
% Minority	53%	49%	54%	27%	69%
% Low Income	15%	13%	21%	8%	10%
Census Tract	N/A	N/A	LA093040200	N/A	N/A
Census Block Group(s)	N/A	LA0930401001	LA0930402001 LA0930402002 LA0930402003 LA0930402004	N/A	N/A

***Includes total parish population demographics.**

Table 2-11: St. Charles Parish communities percent minority and low income.

	St. Charles Parish*	Montz
Total Population	52,880	1,918
% Minority	35%	22%
% Low Income	13%	0%
Census Tract	N/A	N/A
Census Block Group(s)	N/A	N/A

***Includes total parish percent minority and low income.**

Table 2-12: St. John the Baptist Parish communities percent minority and low income.

	St. John the Baptist Parish*	Laplace	Reserve	Garyville
Total Population	45,824	29,872	9,766	2,811
% Minority	61%	59%	65%	
% Low Income	15%	9%	20%	
Census Tract	N/A	LA095070400 LA095070500 LA09507900 LA095071000	LA095070500 LA095070700 LA095070800	LA095070600
Census Block Group(s)	N/A	LA0950703003 LA0950709001	LA0950705001 LA0950707001 LA0950707002 LA0950707003 LA0950707005 LA0950708001 LA0950708002	LA0950706001 LA0950706002

***Includes total parish percent minority and income.**

The communities of Lutcher, Convent, Laplace and Reserve have minority populations of 54 percent, 69 percent, 59 percent and 65 percent, respectively. These communities include a greater percentage of minorities relative to the State and Parish levels. However, they also represent a majority of the population in the study area. Hence, these communities would not be disproportionately impacted by the proposed action. Communities that have low-income populations at or above 20 percent include: Lutcher (54 percent minority) and Reserve (65 percent minority). Because these communities have high minority and low-income populations, they have been identified for further outreach efforts per E.O. 12898.

<u>Future Without-Project Conditions (No Action Alternative)</u>
Direct and Indirect Impacts: There would be no direct impacts. Indirect impacts include continued degradation, under a low RSLR scenario, of wetlands between Lakes Maurepas and Pontchartrain and communities on the east bank of the Mississippi River. These wetlands provide a buffer from hurricane and storm surge risk to minority and low-income residents in the area. Under the no action alternative, residents would continue to incur costs associated with damages to structures, utilities and the local economy following major storm events.

While the area includes a predominantly minority and/or low-income population, there are non-minority and non-low income populations dispersed throughout. People living and working in the area, irrespective of race or income, would be impacted by storm surge events in the future without project condition. There would likely be disproportionate impacts on low-income residents in a mandatory evacuation due to the lack of financial resources. Federal, state, parish and local programs are available to assist all residents in the rebuilding process after storms.

2.4 Natural Environment

2.4.1 Soils, Water Bottoms and Prime and Unique Farmlands

<u>Historic and Existing Conditions</u>: Soils are hydric and non-hydric. Most of the undeveloped area is forested wetlands/swamp habitat comprised of the Barbary-Sharkey soil association. The Convent-Silty alluvial land association is found immediately along the Mississippi River. The Commerce-Sharkey soil association is primarily found on agricultural and undeveloped lands. Convent-Commerce-Sharkey soil association and Convent-Barbary soil association are typically found in undeveloped and rural/suburban/urban developed areas, respectively (USDA 2013).

Water bottoms include Lakes Maurepas and Pontchartrain; the Mississippi and Blind Rivers; Mississippi Bayou and Bayou Fusil; parish canals, such as the Reserve Relief Canal, Hope Canal, and Godchaux Canal; and shallow swamp, ponds and sloughs. Lakes Pontchartrain and Maurepas, and the Mississippi River are state water bottoms. Because of the typical stagnant swamp conditions, the loss of sediment inputs, reduced primary productivity, and limited consolidation, net phosphorus and organic matter export from the swamp is likely low. Therefore, support for dependent systems downstream (e.g., Lake Maurepas) is likely limited and substantially reduced from historic levels (USACE 2010b).

Historically, forested wetlands, swamps and associated water bottoms were typically subjected to flooding and drying events. Water bottoms provided an outwelling of organic matter (Odum 1980) and a sink for phosphorus and nitrogen that supported the health of downstream ecosystems in Lake Maurepas (Lane et al. 2003). However, cessation of near annual Mississippi River floods has limited the capacity of these functions and services.

Approximately 44,672 acres, or 24.2 percent, of the study area meet the soil requirements for prime farmland (NRCS 2013). Not all of these soils are presently utilized for agricultural purposes. In addition, these acres and percentage differ from agricultural land use acres and percentage described in Table 2-1 which indicates only 543 acres are in agriculture. This apparent discrepancy is because Table 2-1 was developed for land loss comparisons in the LCA (2004) study. Nevertheless, this is the only readily available land use information for the area. As such the analysis does not include land uses in over 40 percent of the study area, as indicated in Table 2-1. Unique farmland is not located in the study area. Prime farmland is limited to natural ridge tops and consists of the following soil associations: Cancienne silt loam, Cancienne silty clay loam, Carville silt loam, Gramercy silty clay, Schriever clay, and Vacherie very fine sandy loam. Not all of prime farmlands in the study area are used for agriculture. Crops include mainly common bermudagrass, improved bermudagrass, soybeans, wheat, sugar cane, bahiagrass, and corn. Hydrologic conditions and regulations may prevent some of these areas from functioning to prime capacity. Coordination with the Natural Resources Conservation Service regarding prime farmlands has been completed (Appendix A).

Borrow material for this project could come from the Bonnet Carré Spillyway area between the Mississippi River and Airline Highway or alternative borrow sources not yet identified. The Bonnet Carré Spillway area has been used as a Government Furnished borrow source since 1985. The area has been disturbed by sand haulers maintaining the Spillway, and existing borrow pits are scattered throughout the area. Use of the Bonnet Carré potential borrow site is documented in the 2007 “Final Phase I Environmental Site Assessment, Bonnet Carré Borrow Area, North of Airline Highway, St. Charles Parish, Louisiana.”

<u>Future Without-Project Conditions (No Action Alternative)</u>
Direct and Indirect Impacts: There would be no direct impacts. Existing conditions and changes in the future would persist. The area and the known proposed borrow site would continue to experience changes in RSLR that could potentially affect the spatial limits, depths and frequency of inundation to existing wet (hydric) and non-wet (non-hydric) soils in low lying areas. Existing non-hydric soils could be converted to hydric type soils, and existing hydric soils could become permanent water bottoms as swamp habitats are converted to open water. Portions of the area and the Maurepas Swamp could be permanently inundated under both the intermediate and high RSLR scenarios (Table 2-2). Prime farmlands could be converted to other uses.

Under both the intermediate and high RSLR scenarios (Table 2-2), soils would likely remain nutrient poor, exhibit atypically low bulk densities for forested wetlands due to insufficient sediment content, and exhibit a corresponding loss in soil bearing capacity. There would be continued degradation and conversion of forested wetland and swamp habitats to marsh and open water. Saltwater intrusion from Lakes Maurepas and Pontchartrain during storms would continue. Degradation and conversion of existing swamp habitats (hydric soils) to water bottoms would likely continue resulting in less accretion and continued subsidence. Decomposition of swamp vegetation would initially increase the availability of nutrients and detritus. However, the continued conversion of fresh swamp to marsh and eventually to shallow open water would ultimately decrease available nutrients and detritus for the Maurepas Swamp system.

2.4.2 Vegetation Resources

Historic and Existing Conditions

The area includes forested wetlands, swamps, estuarine emergent wetlands, and submerged aquatic vegetation (SAV). Land cover and habitat analysis is displayed in Figure 2-1. These quantities are based upon the USGS land loss data analysis from the LCA Study (2004) and do not represent land cover or habitats for the entire study area. Hence, the 543 acres (0.29 percent) of agricultural/pasture grassland is not representative of the entire study area. Wetlands in the area provide protection from wave action, erosion, and storm damage and offer various consumptive and non-consumptive recreational opportunities.

Vast virgin stands of bald cypress-tupelo swamp habitat once stretched from the bottomlands of north Louisiana to the Gulf of Mexico (Conner and Day 1976). The Maurepas Swamp was vegetated by an expanse of old growth, freshwater forested swamp that extended as far as 26 miles north from the Mississippi River to the Baton Rouge-Denham Springs fault line. The area was subjected to extensive logging through the 1930s. Remnant logging railroad embankments and canal system used to extract the harvested timber has resulted in increased land loss. Consequently, existing forested wetlands and swamp habitats in the area are rapidly converting to fresh marsh and shallow open water habitats due to impounding, saltwater intrusion, and a lack of nutrient and sediment inputs. This habitat shift has caused a significant loss of wetland functions, including loss of forested wetlands/swamp habitats for wildlife and aquatic species, recreational opportunities, aesthetics, and storm surge protection. To address these forested wetland losses the CBRD and the Maurepas Swamp diversion studies were authorized for study or construction and have made restoration of the most severely degraded portions of the swamp a National priority.

Forested wetlands/swamp and bottomland hardwood forest (BLH) typical dominant and co-dominant species include bald cypress, water tupelo, green ash, swamp red maple, blackgum, diamond oak, black willow, southern wax myrtle buttonbush and Chinese tallow. BLH species in the project area include: swamp red maple, green ash, swamp tupelo, and various oak species. Swamp red maple and green ash typically comprise the sub-dominant mid-story (Beyer et al. 1906, Conner and Day 1976). Scrub species, including black willow, wax myrtle, and buttonbush are sporadically present in areas with diminished canopy cover. Detailed descriptions of common area plants are presented in LCA (USACE 2004, 2010a and 2010b).

SAV communities were historically dominated by native species such as fanwort, coontail, small pondweed, bladderwort, water nymph, widgeon grass, and wild celery. Native SAV communities are largely confined to areas of higher flows, including natural waterways and natural cuts into the swamp interior. Shallow water habitats with insufficient flow may be choked with floating vegetation, greatly limiting light penetration into the water column. SAV are an important food source and habitat for both aquatic organisms and terrestrial wildlife. SAV provides structure and habitat for many invertebrates that are food for various life stages of fish. SAV also provides food for waterfowl and feeding habitat for fish-eating birds such as herons and egrets.

Invasive plants include water hyacinth, alligatorweed, hydrilla, common salvinia, giant salvinia, Chinese tallow, and Chinese privet. These invasive species compete with native flora for resources such as nutrients and light, community structure and composition, and ecosystem processes. Water hyacinth, common salvinia, giant salvinia, and hydrilla all limit the amount of light penetrating the water column. This impacts plankton biomass production. Alligatorweed, Chinese tallow and Chinese privet are of minimal wildlife value and can proliferate until nearly monocultural stands exist, limiting food available for wildlife.

The Louisiana Natural Heritage Program database identifies the following threatened and endangered species and rare, unique or imperiled vegetative communities in the area: cypress-tupelo swamp rare or unique habitats, the bald eagle, alligator snapping turtles, osprey, paddlefish, manatee, swamp milkweed, floating antler fern and rooted spike-rush (LDWF 2013).

<u>Future Without-Project Conditions (No Action Alternative)</u>
Direct and Indirect Impacts: There would be no direct impacts. Existing conditions and trajectories of ecological change to area vegetation would persist. Undeveloped vegetated lands, including wetlands, would continue to be lost to development. Wetlands along major highways would continue to be lost to development as seen along Belle Terre Boulevard in Laplace, and areas north of US-61. Forested wetlands/swamp, BLH and associated sub-canopy species that would be enclosed by the proposed action would continue to be subjected to saltwater intrusion and subsidence, but to a lesser degree. Forested wetlands/swamps would continue to convert to marsh and open water (USACE 2010a and 2010b).

Much of the area, as well as portions of the Maurepas Swamp could be permanently inundated under the intermediate and high RSLR scenarios likely further changing existing habitats. The area would continue to be subjected to increases in RSLR which could increase the geographic extent of saltwater intrusion, potentially convert vast areas of existing forested wetlands and swamp habitats to marsh and eventually open water. There could also be a shift from fresh water dominant species to species that can tolerate higher salinity.

Degradation and loss of forested wetland and swamp habitats will accelerate the decline in interdependent processes of plant production and habitats used by various biota necessary for a stable ecosystem. The moderation of storm surge provided by cypress-tupelo swamp and the contribution of vertical accretion to offset subsidence would be lost.

2.4.3 Wildlife Resources

<u>Historic and Existing Conditions</u>: Table 2-13 shows the status, functions of interest, trends, and projections from 1985 through 2050 for avifauna, furbearers, game mammals, and reptiles in the area (adapted from LCWCRTF & WCRA 1999).

Birds: Area wetlands have historically supported an abundance of neotropical and other migratory and non-migratory birds. Diving ducks, seabirds, rails, coots, and gallinules have preferred the open water habitats of Lake Maurepas and the West Manchac Land Bridge, while wading birds typically utilize fresh swamp habitats in the area. The area also supports the recently de-listed (Endangered Species) bald eagle and colonial nesting waterbird (e.g., herons, egrets, ibis, night-herons, and roseate spoonbills) rookeries. Since 1985, most bird species and species groups in the area have exhibited either increasing or stable populations in the area.

Area forested wetlands, swamp, BLH, and other wetlands provide birds and wildlife with shelter, nesting, feeding, roosting, cover, nursery, and other life requirements. Wetlands provide neotropical migrants with essential stopover habitat on annual migrations (Stouffer and Zoller 2004, Zoller 2004). The greatest threat is habitat loss (American Bird Conservancy 2009). Bottomland hardwood forests provide critical bird breeding habitat (Wekeley and Roberts 1996).

Mammals: Since 1985, furbearer populations have typically remained stable across the Upper Pontchartrain Basin (LCWCRTF & WCRA 1999). Rabbits have experienced declines in the Amite/Blind and West Manchac Land Bridge mapping units, as have squirrels in the West Manchac Land Bridge mapping unit. However, squirrels have remained steady throughout the remainder of the area, whereas deer populations have increased. The West Indian manatee, federally-listed as an endangered species, is known to occur or occasionally enter the area.

Reptiles: Due to the ecological and economic importance of the American alligator, historical and current figures on population numbers are available. In contrast, data on other reptiles in the area is unavailable. LDWF survey data from 1996 to 2000 shows alligator nest densities in the area are classified as medium (approximately 1 nest per 250 acres). Alligator spotlight surveys in the Maurepas Swamp from June to August 2006 found that alligator density, and especially the density of large alligators, appeared to increase with proximity to Lake Maurepas (Fox et al. 2007). There are at least four lizard species, 16 snake species, and 9 turtle species documented in bald cypress-tupelo swamps of southern Louisiana (Dundee and Rossman 1989). The lack of recorded evidence obscures accurate historic and existing conditions for other reptile species that are known or are likely to have inhabited the Maurepas Swamp.

Amphibians: The bald cypress-tupelo ecosystem supports a wide variety of frogs, toads, and salamanders. Abundant water, shelter, and food resources enable several species to thrive. At least 13 frog and toad species and six salamander species inhabit this community type in south Louisiana. Amphibians are often exceptional indicators of wetland ecosystem health. Limited information exists on historic and existing population trends of area amphibians. In a study on similar habitat located in close to the area, Tinkle (1954) observed numerous amphibian species over the course of a year. Literature accounts and museum specimens suggest the presence of pig frogs (Dundee and Rossman 1989) in Ascension and St. James parishes.

Invasive Wildlife Species: Prior to the introduction of nutria to Louisiana in 1930s (USGS 2000, Baroch et al. 2002), no invasive wildlife species were known to be present. A substantial population increase of nutria is attributed to the decline in the price of pelts in 1989 (USGS 2000, Baroch et al. 2002). Areas of extensive nutria damage, or “eat outs,” alter the composition and habitat type of wetland communities (USGS, 2000). Aerial surveys estimated 80,000 acres of marsh in the State of Louisiana were damaged by nutria (Keddy et al. 2007). Throughout the Maurepas Swamp, nutria eat seedling cypress and other forested wetland and swamp tree species preventing regeneration (USACE 2010a).

<u>Future Without-Project Conditions (No Action Alternative)</u>

Direct and Indirect Impacts: There would be no direct impacts. Existing conditions and associated changes into the future would persist. Continued human encroachment and development would result in loss of existing wildlife wetland habitats. The area would be subjected to increases in RSLR which could increase saltwater intrusion and exacerbate ongoing conversion of existing forested wetland and swamp habitats to marsh and open water (USACE 2010a, USACE 2010b). The area and the Maurepas Swamp could be inundated to some unknown extent, under both the intermediate and high RSLR scenarios, thereby potentially reducing available forested wetland and swamp wildlife habitat.

Table 2-13: Status, functions of interest, trends, and projections from 1985 through 2050 for avifauna, furbearers, game mammals, and reptiles with the study area. (LCWCRTF & WCRA 1999)

Mapping Unit	1988 Habitat Type	% of	Avifauna: Bald Eagle Func.	Status	Trend	Proj.	Wading Birds Func.	Status	Trend	Proj.	Dabbling Ducks Func.	Status	Trend	Proj.	Diving Ducks Func.	Status	Trend	Proj.	Raptors Func.	Status	Trend	Proj.	Rails, Coots, and Gallinules Func.	Status	Trend	Proj.
Amite/Blind	FS	73	Ne	Hi	I	I	Ne	Hi	I	Sy	Mu	Lo	Sy	Sy		NH				NH				NH		
	HF	21		NH				NH			Mu	Lo	Sy	Sy		NH				NH				NH		
West Manchac Land Bridge	OW	6		NH				NH			W	Lo	Sy	Sy	W	Lo	Sy	Sy		NH			W	Lo	Sy	Sy
	FM	22		NH			Mu	Hi	I	Sy	W	Lo	D	D	W	Lo	D	D	Mu	Lo	Sy	Sy	Mu	Lo	D	D
	FS	61		NH			Ne	Hi	I	Sy	W	Lo	Sy	Sy		NH			Mu	Mo	I	Sy		NH		
	HF	11		NH				NH			W	Lo	Sy	Sy		NH			Mu	Hi	I	D		NH		
East Manchac Land Bridge	OW	7		NH				NH			W	Lo	Sy	Sy	W	Lo	Sy	Sy		NH			W	Lo	Sy	Sy
	IM	41		NH			Mu	Hi	I	Sy	W	Lo	D	D	W	Lo	D	D	Mu	Lo	Sy	Sy	Mu	Lo	D	D
	FS	15		NH			Ne	Hi	I	Sy	W	Lo	Sy	Sy		NH				NH				NH		
	HF	34		NH				NH			W	Lo	Sy	Sy		NH				NH				NH		

Mapping Unit	1988 Habitat Type	% of	Avifauna (cont.): Other Marsh/OW Func.	Status	Trend	Proj.	Other Woodland Func.	Status	Trend	Proj.	Other Marsh/OW Func.	Status	Trend	Proj.	Other Woodland Func.	Status	Trend	Proj.	Furbearers: Nutria Func.	Status	Trend	Proj.	Muskrat Func.	Status	Trend	Proj.
Amite/Blind	FS	73	Ne	Lo	Sy	Sy	Ne	Mo	I	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
	HF	21		NH			Ne	Hi	I	D		NH			Mu	Mu	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
West Manchac Land Bridge	OW	6	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
	FM	22	Ne	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
	FS	61	Ne	Lo	Sy	Sy	Ne	Mo	I	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
	HF	11		NH			Ne	Hi	I	D		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy
East Manchac Land Bridge	OW	7	Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
	IM	41	Ne	Hi	Sy	Sy		NH			Mu	Hi	Sy	Sy		NH			Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
	FS	15	Ne	Lo	Sy	Sy	Ne	Mo	I	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Mo	Sy	Sy	Mu	Lo	Sy	Sy
	HF	34		NH			Ne	Hi	I	D		NH			Mu	Hi	Sy	D	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy

Mapping Unit	1988 Habitat Type	% of	Furbearers (cont.): Mink, Otter, and Raccoon Func.	Status	Trend	Proj.	Game Mammals: Rabbits Func.	Status	Trend	Proj.	Squirrels Func.	Status	Trend	Proj.	Deer Func.	Status	Trend	Proj.	Reptiles: American Alligator Func.	Status	Trend	Proj.
Amite/Blind	FS	73	Mu	Lo	Sy	Sy	Mu	Lo	D	D	Mu	Lo	Sy	D	Mu	Mo	I	D	Mu	Mo	I	I
	HF	21	Mu	Lo	Sy	Sy	Mu	Lo	Sy	Sy	Mu	Mo	Sy	D	Mu	Mo	I	Sy	Mu	Lo	Sy	Sy
West Manchac Land Bridge	OW	6	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	I
	FM	22	Mu	Lo	Sy	Sy	Mu	Lo	D	D		NH			Mu	Lo	Sy	D	Mu	Mo	I	I
	FS	61	Mu	Lo	Sy	Sy	Mu	Lo	D	D	Mu	Lo	D	D	Mu	Mo	Sy	D	Mu	Mo	I	I
	HF	11	Mu	Lo	Sy	Sy	Mu	Lo	D	D	Mu	Mo	D	D	Mu	Mo	Sy	D	Mu	Lo	Sy	Sy
East Manchac Land Bridge	OW	7	Mu	Lo	Sy	Sy		NH				NH				NH			Mu	Mo	I	I
	IM	41	Mu	Lo	Sy	Sy	Mu	Lo	D	D		NH			Mu	Lo	Sy	D	Mu	Mo	I	I
	FS	15	Mu	Lo	Sy	Sy	Mu	Lo	D	D	Mu	Lo	D	D	Mu	Lo	Sy	D	Mu	Mo	I	I
	HF	34	Mu	Lo	Sy	Sy	Mu	Lo	D	D	Mu	Mo	D	D	Mu	Lo	Sy	D	Mu	Lo	Sy	Sy

Habitat Types: FS = Fresh Swamp; HF = Hardwood Forest; OW = Open Water, FM = Fresh Marsh, IM = Intermediate Marsh. Habitat types comprising less than 5% of unit are shown only if habitat type is particularly rare or important to wildlife.

Status: NH = Not Historically Present; NL = No Longer Present; Lo = Low Numbers; Mo = Moderate Numbers; Hi = High Numbers.

Functions of Particular Interest: Ne = Nesting; St = Stopover Habitat; W = Wintering Area; Hi = High Numbers; Mu = Multiple Functions.

Trends (since 1985) /**Projections** (through 2050): Sy = Steady; D = Decrease; I = Increase; U = Unknown.

Migratory neotropic avian species currently utilize the area as migratory stopover habitat. As forested wetlands and swamp habitats are lost, there would be a corresponding reduction in overall species diversity and abundance.Most mammalian, amphibian and reptilian species would be required to relocate to more suitable swamp habitats. There could be an increase in the population and distribution of nutria due to the conversion of swamp into open water and marsh which are the preferred habitats by nutria.

Future Without-Project Conditions (No Action Alternative)
Direct and Indirect Impacts: There would be no direct impacts. Existing conditions and associated changes into the future would persist. Continued human encroachment and development would result in loss of existing wildlife wetland habitats. The area would be subjected to increases in RSLR which could increase saltwater intrusion and exacerbate ongoing conversion of existing forested wetland and swamp habitats to marsh and open water (USACE 2010a, USACE 2010b). The area and the Maurepas Swamp could be inundated to some unknown extent, under both the intermediate and high RSLR scenarios, thereby potentially reducing available forested wetland and swamp wildlife habitat. Migratory neotropic avian species currently utilize the area as migratory stopover habitat. As forested wetlands and swamp habitats are lost, there would be a corresponding reduction in overall species diversity and abundance. Most mammalian, amphibian and reptilian species would be required to relocate to more suitable swamp habitats. There could be an increase in the population and distribution of nutria due to the conversion of swamp into open water and marsh which are the preferred habitats by nutria.

2.4.4 Aquatic and Fisheries Resources

Historic and Existing Conditions: Plankton and benthic organisms serve as the lowest food resource level for many species of fish and shellfish. Plankton can often be used as an indicator of benthic, nutrient, and water quality health (Stone et al. 1980). Like plankton, benthic invertebrate communities are also good indicators of ecological health. Because many benthic organisms are sessile or have limited mobility, they cannot move away from environmental stressors and therefore community profiles reveal information about the environment's health (Porrier et al. 2009). There is little information available on plankton communities in Lake Maurepas and the upstream Maurepas Swamp waterbodies. Data available for Lake Maurepas suggests the dominance of Anabena, dinoflagellates, diatoms, and cyanobacteria with occasional strong presence of chlorophytes (Atilla et al. 2007).

Benthic macroinvertebrates tend to dominate deepwater swamp invertebrate communities. Characteristic species include crayfish, clams, oligochaete worms, snails, freshwater shrimp, midges, amphipods, and various immature insects (Mitsch and Gosselink 1993). One of the main functions of a benthic community is secondary production, the conversion of plant material by benthic detritivores and herbivores to animal tissue, thereby forming major links in the aquatic food web between plants and predators. Compared to other habitat types, bald cypress-tupelo wetlands may support higher invertebrate densities.

Limited data exists on benthic communities in the area. Species present are likely typical of deepwater forested wetlands and slow-flowing rivers in the region. However, the increased duration of inundation and the low flow and exchange due to impoundment have promoted a system characterized by low DO levels and limited drawdown of water levels to below surface elevations. These conditions likely have resulted in reduced diversity of benthic organisms. Species composition has likely shifted towards species more tolerant of low DO levels, such as oligochaetes and midges. Reduced soil bulk densities and changes in average particle size, texture, and organic content due to low sediment input may further influence habitat suitability and species presence (Day et al. 1989). Within Blind River, woody debris introduced from the adjacent swamp may provide suitable substrate for invertebrates to colonize and thus support benthic community diversity.

The Maurepas Swamp benthic community is seasonally abundant. Typically, winter months have higher DO concentrations when water temperatures are cooler. Organisms found in winter include a variety of segmented and flatworms, snails, crustaceans, and insects. During summer, when lower DO is present, the benthic community is sparse. Air-breathing insects and crustaceans; a few tubificid oligochaetes and dipterans, which can tolerate lower oxygen conditions; and crawfish, especially burrowing crawfish, may be found. During periods when the swamp floor dries, these organisms survive through the resistance stages (eggs, cocoons, etc.) and repopulate the area when water returns to the swamp (Loden 1978).

Salinity strongly influences species composition of invertebrate communities. Higher abundance of benthic organisms has been associated with decreasing salinity from saline to freshwater sites in Louisiana (Philomena 1983). Invertebrate species vary in the range of salinity within which they can survive and their tolerance to fluxes (Day et al. 1989). The Maurepas Swamp, Blind River, and the bayous and canals in the area are primarily freshwater, but salinity intrusion can occur. Throughout the area higher salinity occurs during drought years (Shaffer et al. 2003). The relatively low salinity of these waters provides transitional habitat for freshwater fish and provides nursery and foraging habitat for marine fish and shellfish. Freshwater fish, such as largemouth bass, sunfish, catfish, and crappie are taken by recreational fishermen (LDWF 2009, Hastings 2001). Crawfish and crabs may be harvested from the swamp (Fox et al. 2007).

A survey from January 1976 to August 1977, (Watson et al. 1981) sampled fish species at six locations along Blind River from south of US-61 to Lake Maurepas. The 57 species of finfish collected included 12 estuarine, 43 freshwater, one catadromous and one anadramous species. Freshwater species were dominant both spatially and temporally. Finfish diversity appeared to be higher at the lower stretches of Blind River, below the Amite River Diversion Canal and closer to Lake Maurepas. Multiple studies have been conducted on diversion projects in the area. Data from these studies show an overall decrease in the number of taxa collected. However, different sampling gear and sample locations could explain the trends. Additionally, an overall a trend toward less freshwater species collected is evident (Fox et al. 2007).

Fox et al. (2007) sampled fish at 20 locations in the Maurepas Swamp. There were 26 taxa collected with a total of 1,425 individuals. Spotted gar and striped mullet were dominant species making up 76.5 percent of all fish. Physiochemical data was collected as well, study (Fox et al. 2007) ranged from 1.52 to 6.25, and species richness ranged from 2 to 12 species, indicating a very variable community. Lower diversity, evenness and richness were observed in the interior, in areas of low flow, low DO and low pH. Most of the species specific analyses were consistent with known habitat preferences. For example, spotted gar was negatively correlated with high surface DO levels. This species can breathe air, and it is usually found in hypoxic areas.

<u>Future Without-Project Conditions (No Action Alternative)</u>
Direct and Indirect Impacts: There would be no direct impacts. Existing conditions and associated changes into the future would persist. The area would be subjected to increases in RSLR which could increase saltwater intrusion and lead to increases in and the potential conversion of vast areas of forested wetlands and swamp habitats to marsh and open water. Much of the area, as well as the Maurepas Swamp could be permanently inundated under both the intermediate and high RSLR scenarios. There could be a shift from fresh water dominate species to those species that can tolerate higher salinity.

2.4.5 Essential Fish Habitat (EFH)

Historic and Existing Conditions: Table 2-14 and Figure 2-7 show two EFH species and their likely occurrence in the area by life stage. Blind River and various bayous and canals in the Maurepas Swamp provide EFH, including nursery, foraging, and spawning and breeding grounds. Aquatic and wetland habitats in the area include estuarine emergent wetlands, submerged aquatic vegetation, mud substrates, and estuarine water column. These provide EFH for white shrimp and red drum. Waterbodies and wetlands provide nursery and foraging habitats for a variety of fish, some of which may serve as prey for other fish species designated as EFH species (e.g., mackerel, snapper, and grouper) and highly migratory fishes (e.g., billfish and sharks). The area also provides foraging and nursery habitat for economically important marine fishery resources including striped mullet, Atlantic croaker, blue crab, and Gulf menhaden. The area is important for Federal and state-managed species. It provides foraging and nursery areas for prey species (gulf menhaden and bay anchovy) (Penland et al. 2002) eaten by predators, such as sand seatrout, spotted seatrout, catfish and crappie (LDWF 2009, Hastings 2001), and highly migratory species.

Table 2-14: Essential Fish Habitat for life stages of species in Lake Pontchartrain.

Species	Life Stage (occurrence in project area)	Essential Fish Habitat Zone and Habitat Type
White Shrimp (*Litopenaeus setiferus*)	Adult (rare)	Near shore and offshore sand/shell, and soft bottoms.
	Juvenile (common to abundant)	Estuarine emergent marshes and soft bottoms.
Red Drum (*Sciaenops ocellatus*)	Adult (common to rare)	Estuarine SAV, soft bottoms, sand/shell and emergent marshes. Near shore pelagic and sand/shell, and hard bottom habitat (used for spawning. Offshore sand/shell and hard bottom).
	Juvenile (common to rare)	Estuarine SAV, soft bottoms and near shore sand/shell, and hard bottom.

(GMFMC 2004, NMFS 2013b, USACE 2008, NMFS 2009)

Future Without-Project Conditions (No Action Alternative)

Direct and Indirect Impacts: There would be no direct impacts. Existing conditions and associated changes into the future would persist. The area and the Maurepas Swamp could be inundated to some unknown extent, under both the intermediate and high RSLR scenarios, thereby potentially increasing the extent of saltwater intrusion that could potentially convert existing EFH nursery swamp habitats to marsh and open water EFH.

2.4.6 Threatened and Endangered Species

Historic and Existing Conditions

A complete list of threatened and endangered species and critical habitats in the project area is presented in USACE (2010a) and (USACE 2010b). Two threatened and endangered species, the Gulf sturgeon (*Acipenser oxyrhynchus desotoi*) and the West Indian manatee (*Trichechus manatus*), and one delisted species, the bald eagle (*Haliaeetus leucocephalus*), are known to occur or occasionally enter the area. There are no threatened or endangered plants in the area. The area is also known to support colonial nesting waterbirds (e.g., herons, egrets, and others). The USFWS (personal communication, USFWS January 9, 2009) provided recommendations for minimizing disturbance to colonies containing nesting wading birds during construction. The USFWS recommended that on-site contract personnel be informed of the need to identify colonial nesting birds and their nests, and to avoid affecting them during the breeding season. The recommendations will be followed to the maximum extent practicable.

Figure 2-7: EFH for white shrimp (green) and red drum (red).

West Indian Manatee: Substantial food sources (submerged or floating aquatic vegetation) have not been observed in the area. Given the extensive areas of relatively undisturbed wetlands in the region and the paucity of food sources in the project area, it is considered unlikely for the manatee to frequent and utilize the inshore waters of Lake Maurepas and Pontchartrain as habitat, although manatees could pass through this area while transiting the lake.

Gulf Sturgeon: The area is not Gulf sturgeon critical habitat.

Bald Eagle: The bald eagle was delisted as a federally threatened species for most of the United States; however, it is protected under the Bald and Golden Eagle Protection Act, and the Migratory Bird Treaty Act. Habitats suitable for use by the bald eagle are present in St. Charles, St. John the Baptist and St. James Parishes, and occurrences of the bald eagle have been recorded there. The bald eagle is known to nest and forage in the Maurepas WMA (personal communication, Ms. Brigette Firmin, USFWS on May 10, 2013). According to USFWS maps depicting active and inactive eagle nests, all active nests are beyond 1,500 feet from the proposed project construction sites. The USFWS considers this sufficient distance not to be of concern for potential impacts by construction activities.

Future Without-Project Conditions (No Action Alternative)

Direct and Indirect Impacts: There would be no direct impacts on threatened or endangered species, or their designated critical habitats, bald eagles or colonial nesting waterbirds. The Gulf sturgeon and the West Indian manatee, along with the bald eagle, would continue to occasionally enter the project area. The West Indian Manatee has been infrequently sited near the project area. Continued conversion of forested wetlands and swamp habitat to marsh and open water would provide more favorable conditions for the Gulf Sturgeon and the West Indian Manatee, but would provide only foraging habit for the bald eagle and colonial nesting waterbirds. As forested wetlands and swamp habitats are lost, there would be a corresponding reduction in overall species diversity and abundance.

2.4.7 Cultural and Historic Resources

Historic and Existing Conditions**:** Eight cultural units are used to characterize the prehistoric cultural sequence in southeast Louisiana: Paleo-Indian (10000–8000 B.C.), Archaic (8000–1000 B.C.), Poverty Point (1700–500 B.C.), Tchefuncte (500 B.C.–A.D. 100), Marksville (A.D. 100–500), Baytown (A.D. 400–700), Coles Creek (A.D. 700–1200) and Mississippian/Plaquemine (A.D. 1200–1700). Historic perspectives generally cover the colonial period to approximately 1764, Acadian migration to the area, end of the Colonial period, the Antebellum period, the Civil War, late 19th century reconstruction, and the early 20th century.

The majority of the area contains few cultural resources, although not all areas have been adequately examined for that possibility, especially along natural waterways. The area contains natural levee of the Mississippi River, where numerous historic cultural resources, such as plantation buildings, have been recorded. Although cultural resources surveys have crossed many portions of the project area, undiscovered cultural resources may still exist.

Plantation properties that overlap the area include 16AN30 (Tezcuco Plantation) and 16AN31 (Monroe Plantation), 16SJB8 (Belle Point Plantation), 16SJB10 (Laplace Plantation), 16SJB12 (Sunnyside Plantation), 16SJ11 (Hester Plantation), 16SJ12 (St. Elmo Plantation), 16SJ20 (Wilton Plantation), 16SJ21 (Helvetia Plantation), 16SJ30 (Colomb Plantation), 16SJ34 (St. Rose Plantation), 16SJ49 (Rapidan Plantation), 16SJ37 (Welham Plantation). These often contain outbuildings or components to a plantation operation, and may cover several acres.

Less definable cultural resources located within lands protected by the artificial Mississippi River Levee include 16SC54, 16SC79, 16SJB8, 16SJB66, 16SJ19, 16SJ29, 16SJ64. The site identified as 16SJ1 is a National Register of Historic Places (NRHP) prehistoric site located in agricultural lands, and 16SJ50 and 16SJ51 are additional prehistoric sites that may be contemporaneous and related to site 16SJ1. Further sites include 16SJ5, 16SJ7, 16SJ9, 16SJ15, 16SJ16, 16SJ18, and 16SJ57 that have been determined as ineligible for the NRHP.

Cultural sites on the Mississippi River batture includes 16SJ13, 16SJ31, 16SJ39, and sites 16SJ41 – 16SJ48 that are ineligible for the NRHP. Site 16SJ38 has remnants of the Bourbon Plantation sugar house. Cultural resources in the Maurepas Swamp include parts of rail lines and water crossings used for logging (16SJ71, 16SJ72, 16SJ73). Other recorded resources includes two historic coffins (16SJ58, 16SJ61) eroded from a cemetery probably associated with 19th-20th century Blind River hunting camps. Recorded resources along the shores of Lake Maurepas, Lake Pontchartrain, or waterways include 16SJB4, 16SJB33, NRHP site 16SJB2, the Schloesser Cemetery (16SJB3), and remnant civil war fortifications (16SJB7).

Future Without-Project Conditions (No Action Alternative)
Direct and Indirect Impacts: No direct impacts to cultural and historic resources would occur. Indirect impacts would be the continuation of existing conditions. Changes in RSLR could affect the spatial limits, depths and frequency of inundation to existing cultural and historic resources.

2.4.8 Aesthetics and Visual Resources

Historic and Existing Conditions**:** Aerial photography between 1992 and 2010 shows visual conditions of the area changed over 20 years. The landscape along with view sheds has changed due to development, the conversion of swamps into marsh and open water. Photographs show that the same public thoroughfares that are in place today were in place in 1992; however, the scenery has changed from natural to a more developed state with residential, commercial and industrial development dominating US-61, Louisiana Highway 51 (LA-51) and LA-44, and other corridors. The only major exception is I-10, which traverses the area, giving near unobstructed views of a native landscape that remains aesthetically pleasing. Primary view sheds then, as they are today, were best taken from the local road system, and, in some instances, the Mississippi River levee.

There are two Scenic Streams in or near the area. Blind River stretches south 25 miles from Lake Maurepas, crossing under I-10 and ending near US-61 on the west side of the area. Bayous LaBranche and Trepagnier are located to the east outside of the study area sourcing from Lake Pontchartrain and stretching south, crossing under I-10 and US-61 and ending near the Norco (Bayou Tepagnier) and Good Hope (Bayou LaBranche). Other water resources include the Mississippi River, and numerous canals, streams and creeks that crisscross the native habitat between I-10 and the developed areas along the river (LDWF 2013).

> *"Blind River's surrounding habitat is composed almost entirely of deep, wooded swamp with Spanish moss draped bald cypress and water tupelo being the dominant plant species. The habitat exhibits moderate plant species diversity and moderately high animal diversity. Natural levees and spoil banks provide the only upland habitat available near the river."*

Scenic Byways include the Great River Road traversing US-61. This is but one segment to an overall scenic byway that stretches on multiple thoroughfares from Canada to the Gulf of Mexico. It is state and Federally designated and also has an "All American Road" status, making it significant in culture, history, recreation, archeology, aesthetics and tourism.

Future Without-Project Conditions (No Action Alternative)

Direct and Indirect Impacts: There would be limited to no direct impacts to visual resources. Visual resources would most likely evolve from existing conditions in a natural process, or change as dictated by future land use maintenance practices and policies.

2.4.9 Recreation Resources

Historic and Existing Conditions

The area includes the 103,263-acre Maurepas Swamp WMA. There are a few private camps in the WMA. The LDWF estimates that there were 22,673 WMA recreation users in 2012. Access into the WMA area is generally by boat; however, several locations provide foot access. Consumptive recreation includes hunting deer, squirrels, rabbits and raccoons; fishing for bass, sunfish and crappie; and trapping alligators and nutria. Non-consumptive recreation includes bird watching, sightseeing, and boating. There is a 0.5 mile nature trail and two tent-only camping areas. There is one private recreational camp in the alternative levee alignments.

Many canals and bayous traverse the area, including Pipeline, Hope, Grand Point, and Reserve Relief Canals; and Mississippi and Manchac Bayous. Blind River is one of the most used waterways in the WMA. Recreation includes boating, fishing, hunting, and crawfishing. There is a public boat launch (Hope Canal) in the WMA. There are boat launches near the WMA boundary providing access into the WMA, including Tchakenhou Bayou, Ruddock Canal, Reserve Relief, and St. James Boat Club launch. Additionally, the St. James Boat Club boat launch, funded by the Land and Water Conservation Fund, provides access to Blind River. It includes playground facilities and is used as the Choupique Rodeo Site. Three launches access the I-55 canal. There are no designated parking lots; parking occurs along the highway. The canal provides access to Lake Maurepas. A launch is located at the end of Peavine Road to access Lake Pontchartrain. Three launches are located off US-61, I-55, and I-10. The US-61 launch provides access to Conway Canal and Old New River. The I-55 and I-10 boat launches provide access to adjacent canals and Lake Maurepas.

Cajun Pride Swamp Tours is located off Frenier Road near US-51. This commercial operation provides boat tours in their private refuge and in the Manchac Swamp. Belle Terre Country Club and Golf Course is located in the area. This provides various recreational facilities including a golf course, outdoor swimming pool, and tennis courts. There are local recreational parks including Regala Park, Montz Park, Bethune Park, and Laplace Recreation and Youth Organization (Larayo) Youth Park. Regala Park facilities include an outdoor swimming pool, softball/baseball fields, picnic pavilions, tennis courts, playground, racquetball courts, 1 mile walking path, and soccer field. Montz Park provides a 1,561-foot walking path, baseball fields, basketball courts, playground, and picnic pavilions. Bethune Park provides baseball fields and as does Larayo Youth Park which also provides tennis courts and a swimming pool.

<u>Future Without-Project Conditions (No Action Alternative)</u>
Direct and Indirect Impacts: There would be no direct impacts. Recreational infrastructure would remain vulnerable to surges. Parks, boat launches, and golf courses could be damaged. Storm surge and salt water could have a negative impact on freshwater forests and habitats and could reduce recreational resources (e.g., fishing, hunting, bird watching, and other).

2.4.10 Noise

<u>Historic and Existing Conditions</u>**:** Noise, or unwanted sound, may be objectionable in terms of the nuisance, health, or well-being effects it may have upon humans and the human environment, as well as upon animals and ecological systems (Kryter 1994). Generally, noise is a localized phenomenon. The regulations for Occupational Noise Exposure (29 CFR §1910.95) under the Occupational Safety and Health Act of 1970, as amended, establishes a means for effective coordination of Federal activities in noise control and to provide information to the public regarding noise emissions. There are many different noise sources throughout the area including commercial and recreational boats, and other recreational vehicles; automobiles and trucks, and all terrain vehicles; aircraft; machinery and motors; and industry-related noise.

<u>Future Without-Project Conditions (No Action Alternative)</u>
There would be no direct, indirect or cumulative impacts.

2.5 Cumulative Impacts for the Future Without Project Condition

Cumulative impacts would be the incremental direct and indirect impacts of not implementing a storm risk reduction system for each of the significant resources described above in addition to the direct and indirect impacts attributable to other storm damage risk reduction systems which have not and would not be implemented in the Pontchartrain Basin, Louisiana and the Nation. There is little, if any, published data with which to provide a quantitative comparison regarding proposed hurricane/tropical storm damage risk reduction projects which have not been implemented. Primary cumulative impacts would include the incremental effects of not providing hurricane/tropical storm damage risk reduction. These would be localized and would affect different parts of the area:

- an estimated 62,900 residents and 20,000 residential structures in the area;
- an estimated 70,190 non-farm jobs; 1,900 non-residential structures; 23,800 farm acres;

- projected 165 public and quasi-public facilities;
- transportation infrastructure;
- effects community and regional growth;
- the effects on tax revenues and property values;
- community cohesion effects, especially during hurricane and storm surge events;
- potential effects of not providing risk reduction to minority and low income populations;
- potential degradation and or loss of cultural and historic resources;
- the continued loss of wetland habitats due to human development and conversion of existing forested wetlands and swamp habitats to marsh and open water; and
- potential salt water intrusion and inundation during hurricane and storm surge events.

Figure 2-8: Hurricane Isaac flooding in the River Forest subdivision in Laplace, Louisiana.

3.0 PLAN FORMULATION

Plan formulation is the key to supporting the USACE Civil Works water resources development mission. It is a process requiring experience, analysis, intuition and inspiration. To ensure that sound decisions are made, the process requires a systematic and repeatable approach. The Principles and Guidelines describe the study process for Federal water resource projects. It requires the systematic formulation of alternative plans that contribute to the Federal objective.

3.1 Prior Studies

This study builds upon prior reports and plans. Area problems and opportunities are documented in these reports. Table 3-1 lists relevant reports and studies.

Table 3-1: Relevant prior reports and studies.		**Relevance to WSLP Study**				
Comprehensive Planning Studies		Data Source	Consistency	Structural Measures	Non-Structural Measures	FWOP Conditions
1980	LA Coastal Resources Program	X	X	X	X	X
1999	Coast 2050: Toward a Sustainable Coastal LA	X	X	X	X	X
2004	LA Coastal Area (LCA), LA Ecosystem Restoration Study	X	X	X	X	X
2012	LA's Comprehensive Master Plan for a Sustainable Coast	X	X	X	X	X
Related Hurricane and Flood Damage Risk Reduction Projects and Reports						
1927	"Flood Control, Mississippi River and Tributaries" Published as House Document 90, 70th Congress 1st Session	X	X	X	X	X
1965	Chief of Engineers Report on Lake Pontchartrain and Vicinity, LA Hurricane Protection Project	X	X	X		X
1967	Amite River and Tributaries, Comite River Basin, LA	X	X	X		X
1984	Chief of Engineers Report on Lake Pontchartrain and Vicinity, LA Hurricane Protection Project	X	X	X		X
1990	LA Coastal Area Mississippi River Delta Study	X	X	X		X
1994	LA Coastal Wetlands Restoration Plan	X	X	X	X	X
1994	Southeast LA Hurricane Preparedness Study	X	X	X	X	X
2010	LCA Ecosystem Restoration Study, Volume II of VI, Final Integrated Feasibility Study and Supplemental Environmental Impact Statement for the Amite River Diversion Canal Modification Ascension and Livingston Parishes, LA	X	X	X	X	X
2010	LCA Ecosystem Restoration Study, Volume IV of VI , Final Integrated Feasibility Study and Supplemental Environmental Impact Statement for the LCA Small Diversion at Convent/Blind River St. James Parish, LA	X	X	X	X	X
Previous West Shore Lake Pontchartrain Reports						
1985	West Shore Lake Pontchartrain Initial Evaluation Report	X	X	X		X
1987	Lake Pontchartrain West Shore, LA Hurricane Protection Reconnaissance Report	X	X	X		X
1997	West Shore Lake Pontchartrain, LA Hurricane Protection Project, Reconnaissance Report	X	X	X		X
2003	St. John the Baptist Parish, LA East Bank Urban Flood Control Reconnaissance Report	X	X	X		X

3.2 Planning Constraints

Plans are formulated to achieve objectives. **Objectives** and **constraints** are linked to problems and opportunities. Constraints are restrictions that limit the extent of the planning process.

Planning Constraints

1. Minimize impacts to wetlands.
2. Minimize impacts to the Small Diversion at Convent/Blind River project and River Reintroduction into Maurepas Swamp project.
3. No loss of flood protection from existing flood damage reduction projects.
4. Minimize impacts to the Maurepas Swamp Wildlife Management Area and surrounding wetlands.
5. Minimize infrastructure impacts (pipelines, highways, hospitals, schools, fire stations, and police stations).

3.3 Management Measures Considered and Screened (*NEPA required)

A **management measure** is a feature (a *structural element* that requires construction or assembly on-site) or an activity (a *non-structural action*) that can be implemented at a specific geographic site to address one or more planning objectives. They can be used individually or combined with other management measures to form alternative plans. Measures were developed to address problems and to capitalize upon opportunities. They were derived from a variety of sources including prior studies, the public scoping process, and the team.

This study considered structural measures and non-structural measures to provide risk reduction and maximize project benefits. All measures were screened for capability to meet objectives and avoid constraints, for engineering and economic feasibility, and for the level of risk reduction provided over the period of analysis (2020 to 2070). Measures that warranted continued consideration were assembled into **alternative plans**. Below are the structural and non-structural measures that were considered. Those measures carried forward for further consideration are shown in blue boxes. Figure 3-1 illustrates some of these measures. Detailed information about the measures and screening process can be found in Appendix E.

Non-Structural Measures

- **Full Acquisition/Buy-out**: This measure would involve the relocation of residents outside of the floodplain by physically moving structures or by purchasing replacement structures. An acquisition program would reduce flood vulnerability and decrease future flood damages. *Carried forward for further consideration.*
- **Limited Acquisition/Buy-out**: This measure would remove structures that receive repetitive damages from high frequency storm events (1 year, 5 year, 10 year, and 25 year frequencies). *Carried forward for further consideration.*
- **Flood-proofing and Elevation**: This measure would raise residential structures above the 2070 floodplain and flood-proof other structures, such as public facilities, to reduce damages. *Carried forward for further consideration.*
- **Floodplain Management Measure**: This measure would update local floodplain zoning rules based on changes due to RSLR. *Carried forward for further consideration.*
- **Cypress Reforestation**: This measure would enhance and/or restore forest on the Maurepas Landbridge and in the Maurepas Swamp to reduce surge heights. *Eliminated from consideration because it would be ineffective in reducing the level of risk reduction.*
- **Flood Forecast and Warning Measures**: This measure would involve more robust flood forecasting and warning systems. *Eliminated from consideration because the area has an ample forecast/warning system provided by local government. NOAA, FEMA,*

and the USACE already take the responsibility of producing storm surge maps under existing floodplain management authorization.

Structural Measures

- **Levees/Floodwall**: This measure would reduce storm surge damages. *Carried forward for further consideration.*
- **Control Structures on Canals and Bayous**: This measure involves the placement of control structures on canals and bayous to reduce the risk of flood damages. *Carried forward for further consideration.*
- **Seawall**: This measure would construct a seawall along the rim of Lakes Maurepas and Pontchartrain. *Eliminated because it would have adverse environmental impacts by enclosing swamp, and would stop drainage systems by preventing water exchange with Lake Maurepas. Mitigation features for this measure would not be cost effective.*
- **Floodgates on Tidal Passes**: This measure would place a large tide control structure on Pass Manchac, and potentially North Pass, to prevent storm surge from entering the area. *Eliminated from consideration because it would have adverse impacts on the environment and drainage systems by restricting tides and limiting the ability of the upper basin to drain during storms. The mitigation features would be cost prohibitive. Additionally, it would be ineffective due to surge flanking.*
- **Highway/Levee**: This measure would raise the I-10 roadbed to serve as a levee to reduce risk of surge damage. *Eliminated from consideration because it would require massive changes to the highway system, and would require replacement of the highway during scheduled levee lifts.*

3.4 Initial Array of Alternatives (*NEPA required)

Structural Measures were combined into an **initial array of 12 alternative plans**. These plans started in the eastern portion of the study area, and were incrementally expanded to the west. Maps and detailed descriptions of each of the alternative plans can be found in Appendix E.

- **Plan 1**: Levees/floodwalls from the Bonnet Carré Spillway to Reserve Canal.
- **Plan 2**: Levees/floodwalls from the Bonnet Carré Spillway to East St. John High School.
- **Plan 3**: Levees/floodwalls from the Bonnet Carré Spillway to East St. John High School following the wetland/non-wetland interface.
- **Plan 4**: Levees/floodwalls from the Bonnet Carré Spillway to East St. John High School offset from I-10.
- **Plan 5**: Levees/floodwalls from the Bonnet Carré Spillway to Marathon.
- **Plan 6**: Levees/floodwalls from the Bonnet Carré Spillway to Reserve enclosing US-51.
- **Plan 7**: Levees/floodwalls from the Bonnet Carré Spillway to Marathon following the wetland/non-wetland interface.
- **Plan 8**: Levees/floodwalls from the Bonnet Carré Spillway to Ascension Parish/Mississippi River.
- **Plan 9**: Levees/floodwalls from Bonnet Carré Spillway to Hope Canal/Mississippi River.
- **Plan 10**: Levees/floodwalls from the Bonnet Carré Spillway to the Hope Canal/Mississippi River enclosing I-10.
- **Plan 11**: Levees/floodwalls from the Bonnet Carré Spillway to the Hope Canal/Mississippi River with pipeline avoidance.
- **Plan 12**: Levees/floodwalls from the Bonnet Carré Spillway to Ascension Parish enclosing I-10.

Figure 3-1: Typical levee, floodwall (T-wall) and control structure.

To determine if the plans were viable for further evaluation each plan was scored from 5 (high performing) to 1 (low performing) based on how well it met objectives and avoided constraints. The scores were totaled and the plans were compared, evaluated and screened.

After reviewing the aggregate scores, Plans 1 - 6 were eliminated from further consideration because they did not maximize the planning objectives. Plans that could induce flooding to communities outside of the risk reduction system or divided communities were eliminated from consideration because they were considered unacceptable.

Plan 7 and Plan 9 alignments followed the wetland/non-wetland interface through St. John the Baptist Parish. However, Plan 7 would not provide risk reduction to the town of Garyville. By increasing the length of the levee by 500 feet, Plan 9 provided risk reduction to Garyville while only minimally increasing costs. Plan 7 was thus eliminated. Plan 8 and Plan 12 would provide risk reduction to the same area. The difference between the two Plans was the tie-in points at the two closest high ground areas to prevent storm surge from flanking the levee. Plan 12 would extend into Ascension Parish and tie into the Marvin Braud pump station. Plan 8 would tie into LA-70 in St. James Parish adding 4 miles to the alignment. Plan 12 was carried forward instead of Plan 8 because it was less costly and the direct environmental impacts were less than Plan 8.

The four remaining structural plans were carried forward: Plan 9, Plan 10, Plan 11 and Plan 12.

Structural and non-structural measures were combined to form additional plans. A plan was developed to evaluate a stand-alone non-structural plan which would acquire or elevate 14,486 structures in the flood plain. The non-structural plan cost $3,260,000,000 far exceeding estimated benefits and the cost of other alternatives. The stand-alone non-structural plan was eliminated from further evaluation, but it was determined that portions of this plan could be carried forward to complement the remaining structural alignments. After screening the structural plans, the remaining plans (Plan 9, Plan 10, Plan 11 and Plan 12) were evaluated to identify if there was a risk of storm surge-related damage that was not addressed by the structural alignments. While Plan 12 would provide risk reduction to most of the developed study area, Plans 9, 10, and 11 would not provide risk reduction to St. James Parish. Additionally, two communities within St. James Parish, Lutcher and Convent, could be considered Environmental Justice communities per Executive Order 12898.

Non-structural measures were added to complement Plans 9, 10, and 11 to address the risk of potential storm surge-related damages to areas west of Hope Canal. With the inclusion of the non-structural measures, Plans 9, 10, and 11 would provide benefits commensurate with Plan 12 (Figure 3-2).

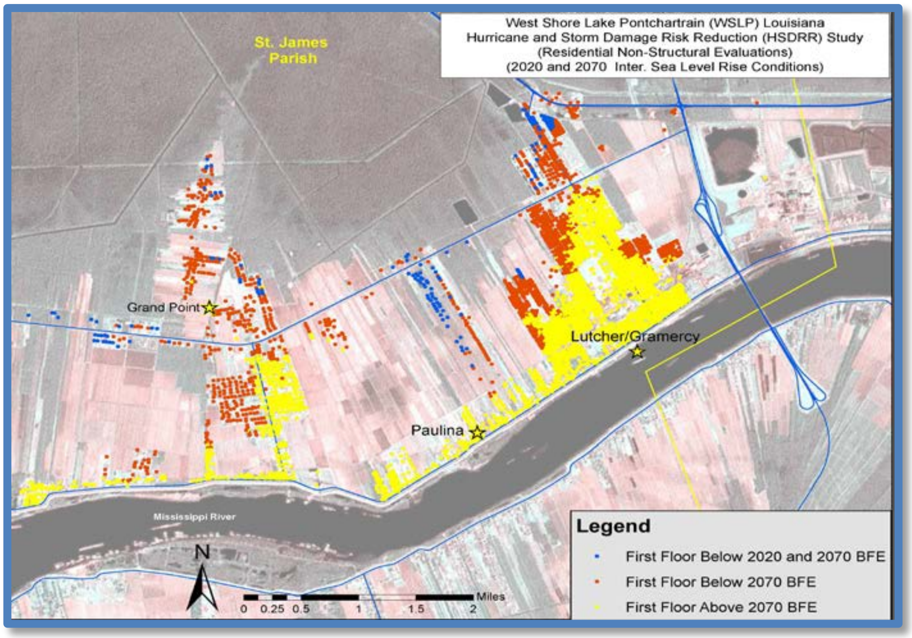


Figure 3-2: Supplemental non-structural plan area in St. James Parish.

The number of structures expected to be impacted by storm surge is highly influenced by RSLR. Under the base condition (year 2020) damages in St. James Parish resulting from a 1% annual exceedance probability (AEP) storm event would impact approximately 219 structures. This is expected to increase with the effects of RSLR over the 50-year period of analysis to 1,571 structures out of a total of 4,921 structures. Due to the uncertain impacts of RSLR, a range of costs were developed based on a minimum expected number of structures based on the 2020 floodplain and a maximum number of structures based on the 2070 floodplain. During feasibility level design, further analysis on the non-structural features will be conducted by economic reach to determine the economic feasibility of the non-structural features (Figure 3-3).

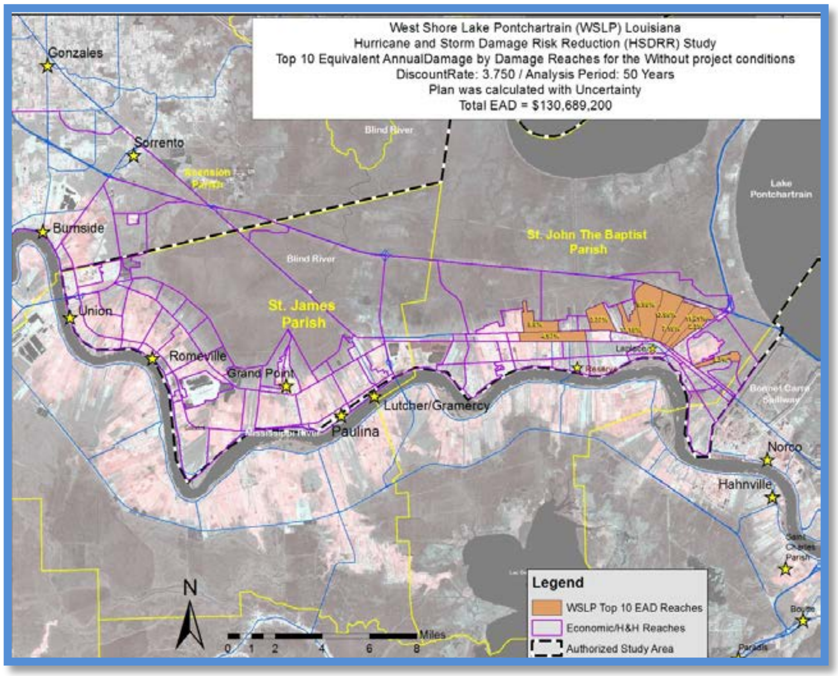


Figure 3-3: Economic reaches, FWOP condition.

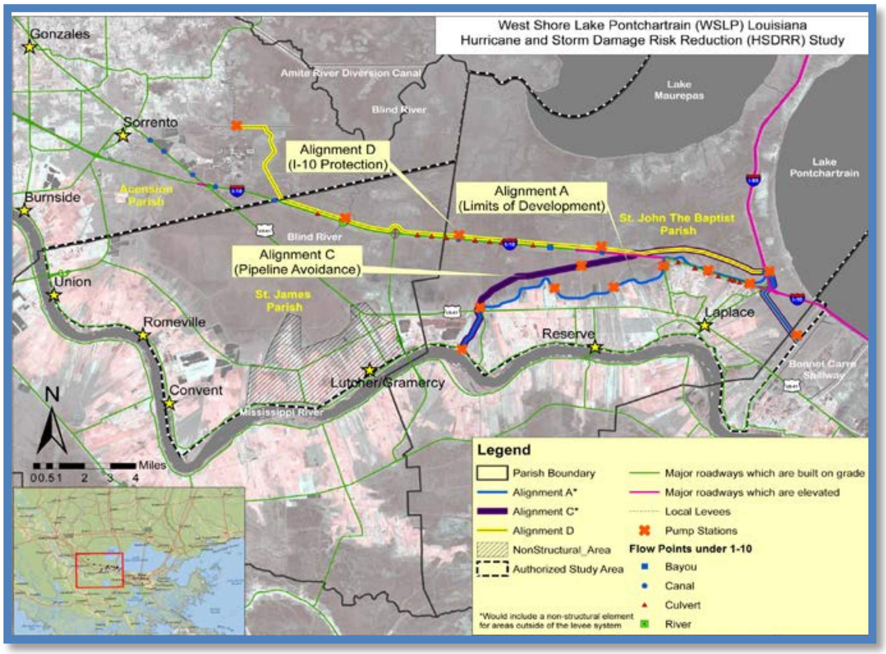
Four plans with non-structural measures were carried forward and identified as follows:

Plan 9 + non-structural → **Alternative A**
Plan 10 + non-structural → **Alternative B**
Plan 11+ non-structural → **Alternative C**
Plan 12 → **Alternative D**

These alternatives were further evaluated considering alignments with respect to the I-10 corridor. Alternative B would not provide greater risk reduction for the evacuation routes than any of the other plans. Alternative B would reduce risk to the same number of structures as Alternative C but would enclose approximately 4,000 more acres of wetlands. Based on this, Alternative B was eliminated.

3.5 Final Array of Alternatives (*NEPA required)

The final array of alternatives carried forward for consideration included **the No Action Alternative**, **Alternative A**, **Alternative C**, and **Alternative D** (Figure 3-4). Engineering details on each can be found in Appendix B. Comparative details are shown in Table 3-2. The team assumed that Alternatives A, C, and D would provide equal levels of risk reduction. The least costly plan would have the highest net benefits. Analysis is based on a 1% AEP storm event.



No Action Alternative (Future without-project condition)

Under the No Action Alternative no risk reduction would occur. The area would continue to experience storm surge damage. This would be exacerbated by RSLR and increased impacts to wetlands due to salinity. As wetlands erode and subside, they would provide less risk reduction.

Figure 3-4: Final array of alternative plans.

Table 3-2: Comparative details for final array of alternative plans.

Alternative	Length of Alternative	Size of Study Area Behind Alternative	Number of Structures Behind Alternative	Communities Behind Alternative	Miles of I-10 Behind Alternative	Wetlands Behind Alternative	Number of Pipeline Crossings
A	20 miles	38 sq miles	16,919	Montz, Laplace, Reserve, Garyville	4 miles	~5 sq miles	70
C	18 miles	47 sq miles	16,919	Montz, Laplace, Reserve, Garyville	4 miles	~16 sq miles	36
D	28 miles	160 sq miles	21,840	Montz, Laplace, Reserve, Garyville, Lutcher, Gramercy, Grandpoint	15 miles	~79 sq miles	14

Alternative A: Bonnet Carré Spillway to the Hope Canal to Mississippi River

Alternative A (Figure 3-5) would provide risk reduction to St. Charles, St. John the Baptist and St. James Parishes. The approximately 20.41-mile levee and floodwall alignment begins at the West Guide levee of the Bonnet Carré Spillway, north of transmission line and pipeline corridors and extends west around the interstate interchange and along the wetland/non-wetland interface. The alignment turns south near Hope Canal, until it reaches the Mississippi River Levee (MRL). Elevation and/or acquisition of structures outside of the alignment would reduce risk of storm surge-related damage in areas west of the Hope Canal.

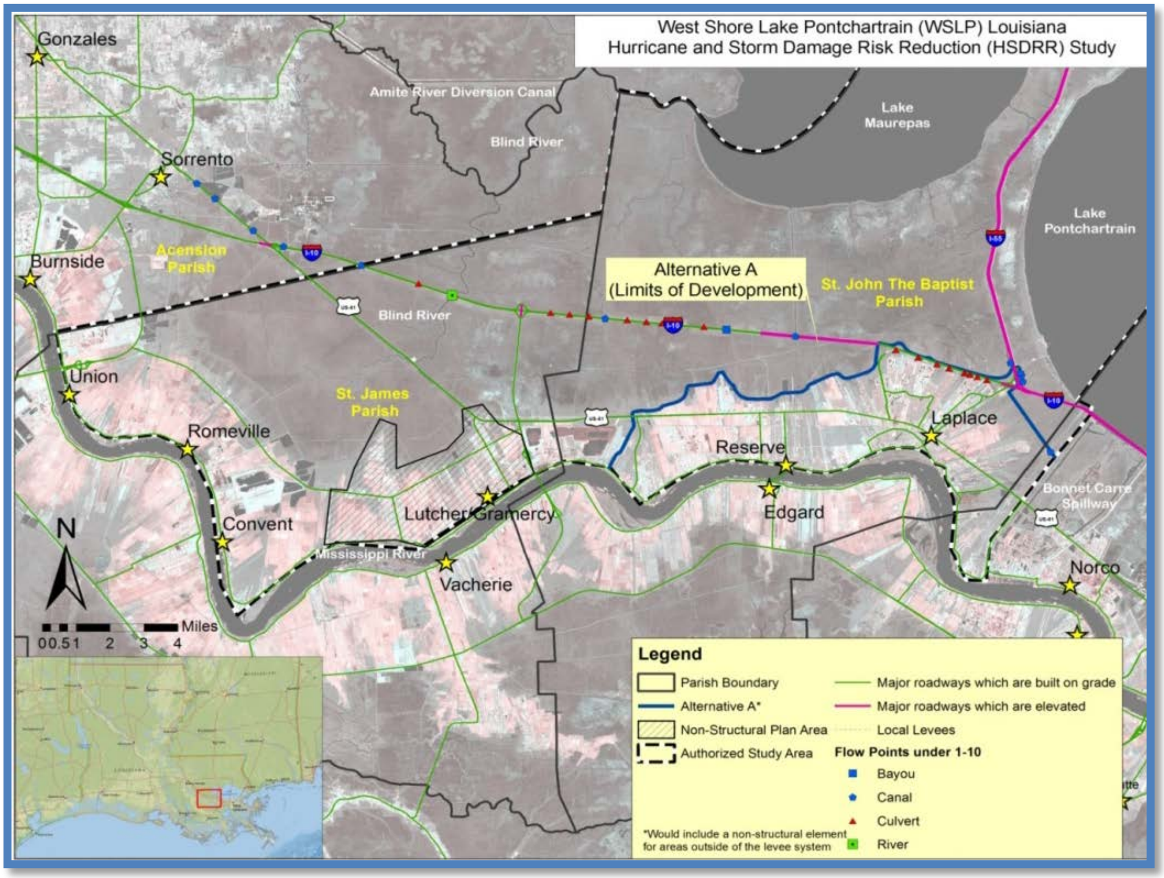


Figure 3-5: Alignment and features of Alternative A.

Construction would require roughly 3,100,000 cubic yards of earthen borrow material; 3,700,000 yards of geotextile fabric; 30,000 cubic yards of aggregate limestone road; nearly 5,000 linear feet of T-walls to cross under the interstate, or as frontal risk reduction for pump stations; 1,200 linear feet of flood gates; 240 linear feet of drainage gates; and 2 railroad gates. Eight pump stations on the alignment would require 25,000 cubic yards of concrete, 230,000 square feet of sheet pile, nearly 7,000 tons of riprap, and 151,000 linear feet of concrete piles. Multiple culverts with flap gates would be constructed. Because the alternative hugs the wetland/non-wetland interface, Alternative A has the least adverse wetland impacts. However, the plan has the greatest residual risk (the risks left after all construction and safety measures have been assessed) because overtopping of the levee by surge would cause immediate inundation of populated areas. It also has the most pump stations which results in more maintenance and greater risk of system failure. It is the least adaptable because expansion of the levee would require the purchase and/or relocation of existing structures. The plan does not reduce risk to infrastructure in St. James Parish.

Alternative C: Bonnet Carré Spillway to the Hope Canal to Mississippi River

Alternative C (Figure 3-6) evaluates the feasibility of avoiding multiple pipeline and utility crossings. It follows the Alternative A alignment between the West Guide levee of the Bonnet Carré Spillway to the US-51 interchange, where it then tracks north across US-51 and along a pipeline transmission corridor. The approximately 18.27-mile alignment crosses I-10 and follows the pipeline corridor through wetlands near the Belle Terre exit until it reaches Hope Canal. The alignment then turns south and extends to the MRL. Elevation and/or acquisition of structures outside the alignment would reduce risk of storm surge-related damage to structures in areas west of the Hope Canal.

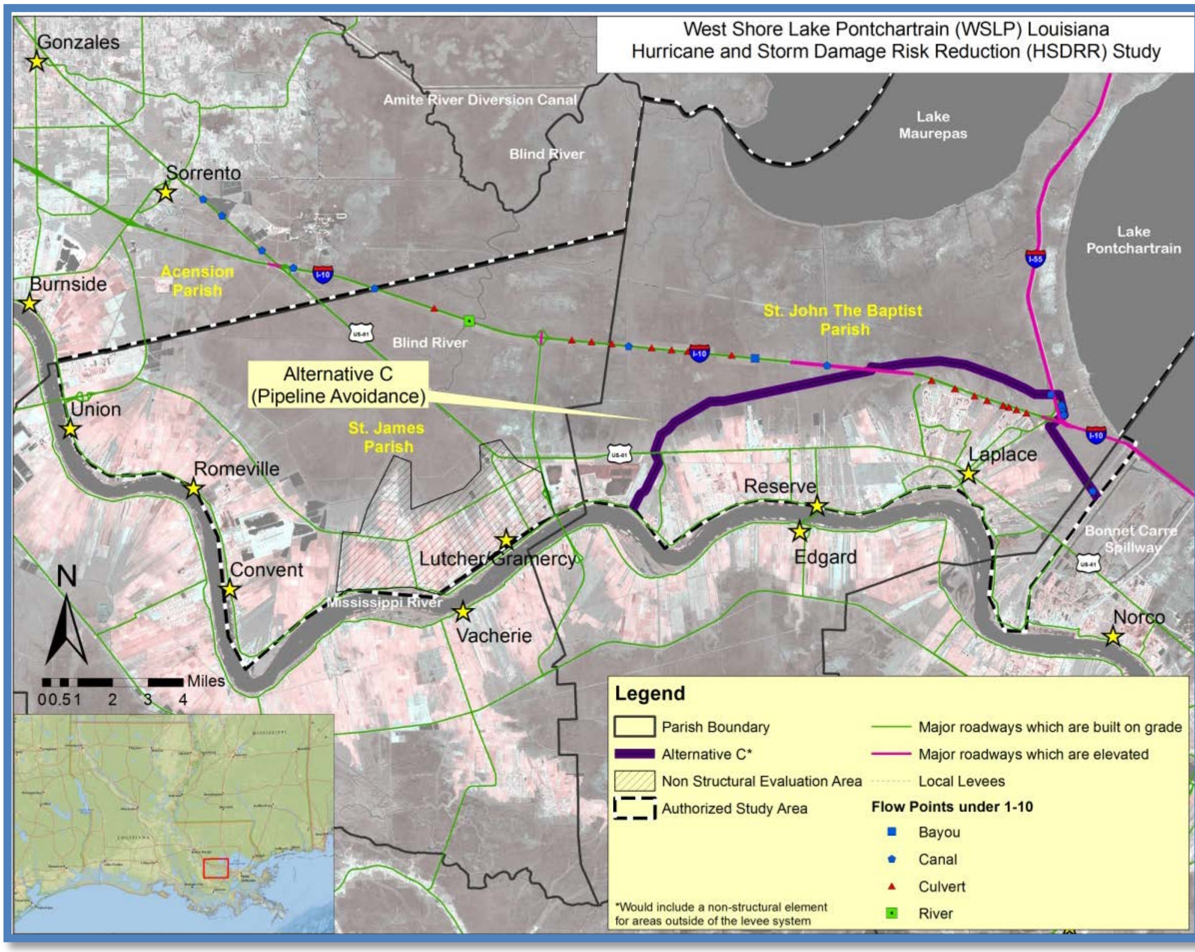


Figure 3-6: Alignment and features of Alternative C.

Construction of the alternative would require roughly the same amount of borrow material as Alternative A. It would require 3,365,000 cubic yards of geotextile fabric; nearly 26,000 cubic yards aggregate limestone road; 5,300 linear feet of T-walls; 300 linear feet of flood gates; 200 linear feet of drainage gates; 4 pump stations; and 2 railroad gates. Environmental structures similar to those identified for Alternative A would be built. This alternative encloses more wetlands than Alternative A, and would require more environmental structures, but has less residual risk because levee overtopping would not immediately inundate populated areas. It is more adaptable should changing conditions require modifications to the structures because the alignment does not abut existing structures. However, the plan does not reduce risk to infrastructure in St. James Parish.

Alternative D: Bonnet Carré Spillway to Ascension Parish

Alternative D (Figure 3-7) is a westward extension of the Alternative C alignment along the I-10 corridor into Ascension Parish. It continues west at the St. James Parish line slightly north of I-10 until it reaches the Old New River, where it proceeds north to the non-Federal Laurel Ridge levee in Ascension Parish. Measures to maintain water flow and to reduce impacts to enclosed wetlands would be built. Alternative D reduces risk to communities in St. Charles, St. John and St. James Parishes and provides a level of risk reduction to a segment of the I-10 hurricane evacuation route.

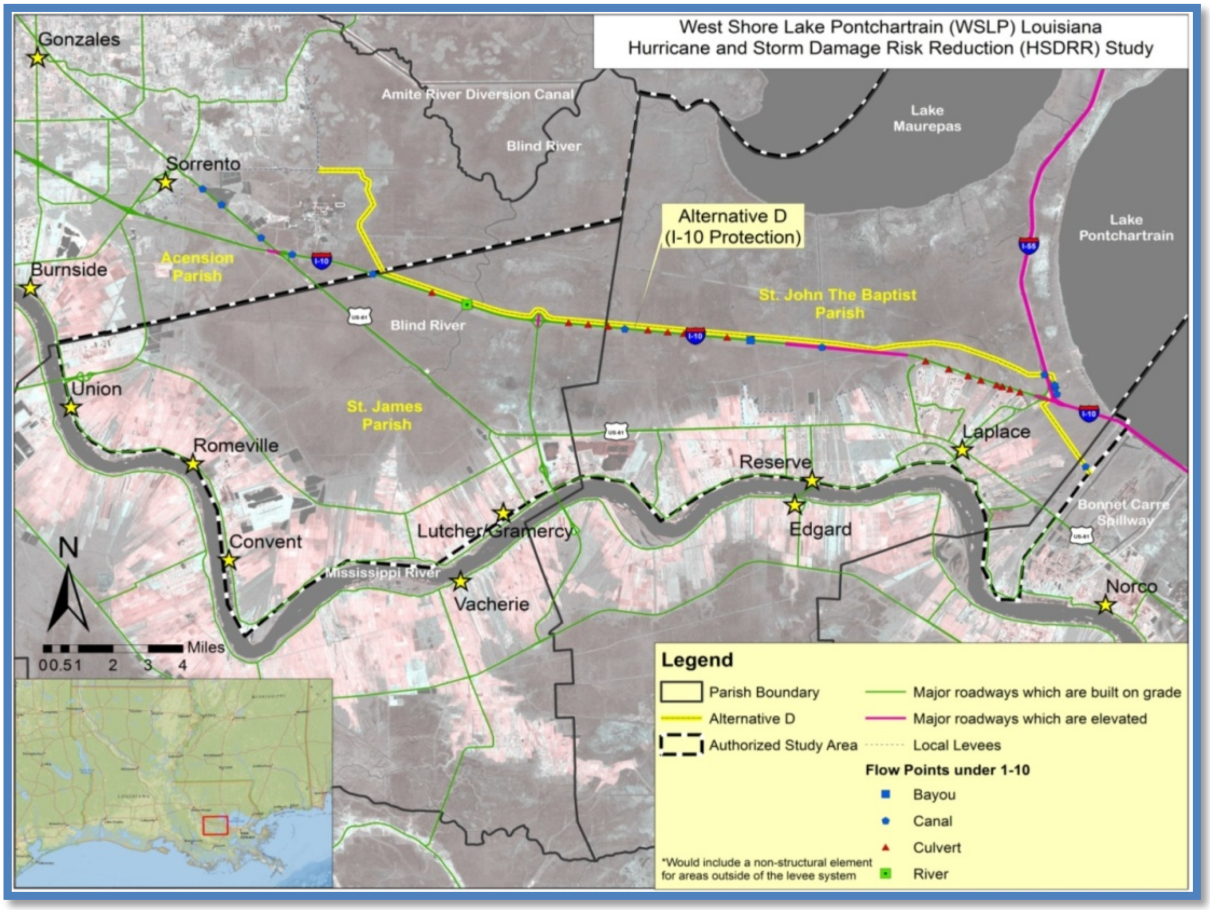


Figure 3-7: Alignment and features of Alternative D.

Construction of the approximately 28-mile alternative would require 3,700,000 cubic yards of borrow material, 3,037,000 square yards of geotextile fabric; approximately 37,000 cubic yards of aggregate limestone road; just over 4,000 linear feet of T-walls; 300 feet of flood gates; 400 feet of drainage gates; approximately 6 pump stations; nearly 24,000 cubic yards of concrete; almost 200,000 square feet of sheet pile; approximately 5,900 tons of rip rap; 154,000 linear feet of concrete piles; and environmental structures, most notably at Blind River, a Louisiana Scenic River. It encloses the most acres of wetlands requiring more environmental structures than any of the other alternatives. Each of these structures would require maintenance because failure of the environmental structures could increase adverse environmental impacts. The greater number of structures results in more maintenance and a greater risk of failure. There is concern about potential impounding of large areas of wetlands under this alternative, especially if the river diversion projects are constructed. Alternative D provides the greatest structural risk reduction and would reduce risks to roads and other infrastructure in St. James Parish.

3.6 Cost Estimates

Estimated costs for levees, floodwalls, and pump stations; real estate costs; operation and maintenance, repair, rehabilitation and replacement (OMRR&R); environmental mitigation; and non-structural features were totaled for each alternative and compared to each other to help identify a TSP. Costs for the non-structural features of Alternative A and Alternative C, and costs associated with mitigation for indirect impacts are uncertain. For this reason, a range of costs was developed for each feature.

Non-structural Cost: Non-structural costs were based on a 100% structure survey of area improvements. The cost of raising and/or acquiring structures located in the 2020 and 2070 100-year floodplains was evaluated by comparing the cost of elevating the structure to the cost of acquiring the structure. The lesser cost was used to determine the cost of the non-structural feature. RSLR greatly impacts the number of structures to be raised, resulting in uncertainty as to how many structures would have to be raised by any given date. A minimum cost of the non-structural feature of $53,143,789 was developed based on the cost of reducing risk to structures in the 2020 100-year floodplain. A maximum cost of $305,256,794 was developed based on the cost of reducing risk to structures in the 2070 100-year floodplain. The maximum cost was used for comparison.

Indirect Impact Cost: At this stage, mitigation costs for indirect impacts remain uncertain due to limited hydrologic information and lack of a full wetland value assessment (WVA). To reduce the uncertainty of costs associated with mitigating for indirect impacts, a maximum cost based on Morganza to the Gulf and Lake Pontchartrain and Vicinity project estimates, and a minimum cost based on local mitigation bank costs were developed. These costs were averaged. In place of WVA analysis, habitat reduction values from 5 - 75 percent were calculated. Using these values, the average estimated mitigation cost associated with indirect impacts ranged from $871,000,000 to $980,000,000 for Alternative A, $844,000,000 to $1,000,000,000 for Alternative C, and $672,000,000 to $2,200,000,000 for Alternative D.

Based on available information, the habitat reduction value impacts are estimated to be approximately 15 percent of the total enclosed wetlands, as shown in Table 3-3. The risk reduction features will be designed to maintain existing hydrologic flows to the extent practicable. If this can be achieved, indirect impacts would be limited to those that occur during closure of structures for storm surge events – an estimated 8.5 days per year. A WVA analysis based on hydrologic modeling will be conducted on the TSP during feasibility design.

Table 3-3: Estimated first costs for final array of alternative plans.

	Alternative A	Alternative C	Alternative D
Levees & Floodwalls	$335,898,670	$334,156,997	$339,508,346
Pump Stations	$132,162,500	$112,687,500	$166,437,500
Pipeline Relocations	$70,300,000	$35,100,000	$11,693,750
Real Estate	$3,849,000	$3,283,000	$2,434,000
Direct Habitat Impacts	$17,000,791	$35,710,811	$43,323,364
Indirect Mitigation Cost (15%)	$23,123,679	$54,655,968	$327,687,626
Non-Structural 2070*	$305,256,794	$305,256,794	$0
Total Cost	**$887,591,434**	**$880,851,070**	**$891,084,586**

***Some non-structural costs will be LERRD costs that are the responsibility of the NFS. The non-structural costs will be spread over the entire period of analysis and will be heavily discounted and result in less than 17% of the total average annual costs.**

OMRR&R Cost: Table 3-4 provides preliminary OMRR&R cost estimates for each alternative. Annual costs will be refined during feasibility level design and analysis. Upon notice of completion of construction of the project, or a functional portion of the project, the CPRAB shall commence OMRR&R responsibilities for the project (Chapter 8).

Table 3-4: Comparison of annual OMRR&R cost for final array of alternative plans.

Alternative	Levee Grass Cutting		Structure OMRR&R ($)	Total OMRR&R ($)
	(acres)	($)		
Alternative A	390	$234,000	$7,277,050	$7,511,050
Alternative C	868	$520,800	$3,607,275	$4,128,075
Alternative D	1269	$761,400	$5,421,538	$6,182,938

NOTE: Based on levee right-of-way acreage, 2012 dollars, and includes a 25% contingency. OMRR&R costs for mitigation are not included. Cost include grass cutting; pump station and flood gate replacement; and other planned OMRR&R activities.

3.7 Summary of Accounts and Comparison of Alternatives

Plans in the final array are assumed to provide equal levels of risk reduction. To facilitate evaluation and comparison of the alternatives, four Federal Accounts were used to assess the effects of alternatives. The accounts are National Economic Development (NED), Environmental Quality (EQ), Other Social Effects (OSE), and Regional Economic Development (RED).

No Action Alternative: No NED benefits would be associated with the No Action Alternative. There would continue to be adverse impacts to the EQ as salinity levels increase in the area, affecting wetlands and eventually causing impacts to residents (OSE) in the immediate vicinity of the study by reducing the natural swamp buffer. Reducing the natural buffer could also cause uncertainty to RED by impacting major oil refineries in the region and the overall economy.

Alternative A: Alternative A provides NED benefits, but provides less net benefits than Alternative C. It encloses the fewest acres of wetlands, resulting in the least adverse impacts to EQ. However, it risks immediate inundation of developed areas in an overtopping event; thus reducing safety to residents (OSE) in the area. It limits future modification or reinforcement of the system due to its proximity to existing structures. It would also risk disruptions to the local drainage patterns northward if design parameters are exceeded. (Figure 3-8). While Alternatives C and D would disrupt existing drainage if design parameters are exceeded, the damage resulting would be greatest for Alternative A due to

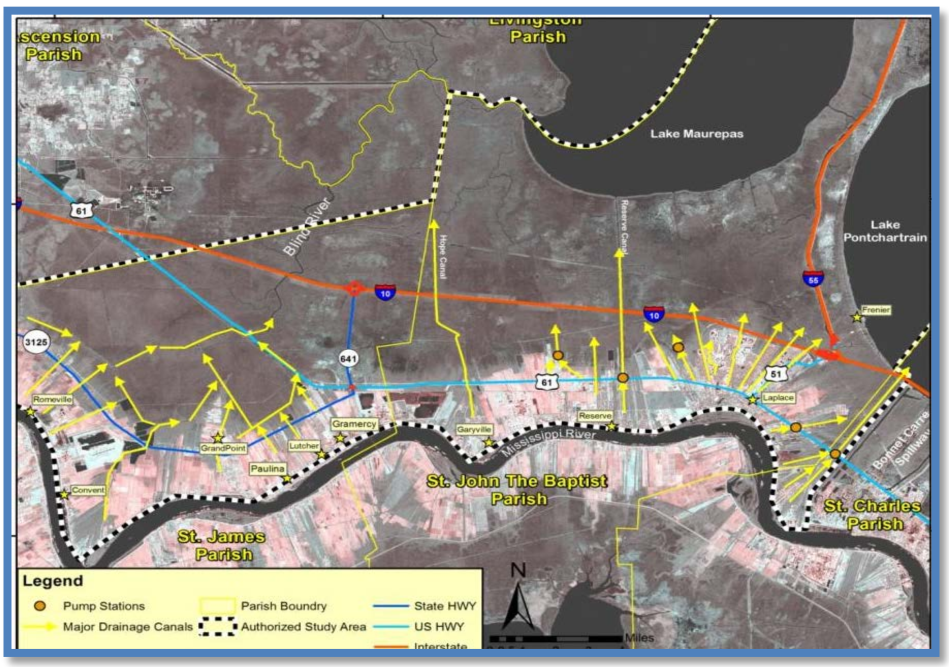


Figure 3-8: Study area drainage patterns.

the close proximity of the levee to existing structures. There is no risk reduction to roads in St. James Parish which could flood, preventing employees from accessing vital industries.

Alternative C: Alternative C maximizes benefits. It has more adverse impacts on EQ than Alternative A but reduces impacts to wetlands compared to Alternative D. In case of a major storm surge event that exceeds the federally authorized project design, Alternative C could reduce the risk to OSE because storm surge would, over time, first fill in the wetlands before potentially inundating developed areas. Because this alternative addresses an uncertain yet reasonably foreseeable need to modify the system, it could provide stability to RED in developed areas. The alignment can be enlarged should RSLR be greater than anticipated without displacing area residents. There is no risk reduction to roads in St. James Parish.

Alternative D: Alternative D provides NED benefits, but does not maximize those benefits. It provides risk reduction to a larger area thus reducing risk to more area residents. Structural risk reduction is provided to roads in St. James Parish, reducing the risk that employees would be unable to access critical infrastructure and places of employment. Additionally, because the levee is not located in close proximity to existing structures, the threat of flooding due to exceedence of design parameters is lessened. Alternative D poses potential uncertainties concerning the impoundment of large areas of wetlands, especially if the river diversion projects are constructed. While it would prevent saltwater intrusion, it would risk impacting hydrology by enclosing approximately 54,800 acres of swamp and would impact the EQ of the Maurepas WMA as well as Blind River, a Louisiana Scenic River. Per the Wild and Scenic River Act, construction within 100 feet of a scenic stream requires a permit.

Economic Costs Comparison: The parametric implementation costs were annualized using the current interest rate (3.75%) and a 50 year period of analysis (2020-2070) as shown in Table 3-5. In 2020, only 5% of the benefits are derived from St. James Parish and only 219 structures are located within the 100-year floodplain. The cost of the non-structural feature for Alternatives A and C increases from approximately $53,000,000 (in year 1) to over $305,000,000 (in year 50) due to RSLR. Most of the structures would not reside in the 100-year floodplain until the later years of the period of analysis. Because of this, the non-structural costs were spread evenly over a 53-year period beginning in 2017 and ending in 2069; and then compounded or discounted to the 2020 base year. The annual benefits were compared to the cost assuming a 100-year level of risk reduction. The total annual benefits were then compared to the total annual costs.

Table 3-5: Economic comparison of final array of alternative plans.

Alternative	Implementation Costs ($ millions)	Annual OMRR&R ($ millions)	Equivalent Annual Benefits ($ millions)	Annual Costs ($ millions)	Benefit-to-Cost Ratio	Annualized Net Benefits ($ millions)
A	887.6	7.5	59.9	40.5	1.48	19.4
C	881.0	4.1	59.9	36.8	1.63	23.0
D	891.1	6.2	59.9	46.7	1.28	13.2

Alternative C has the lowest cost and the highest net benefits followed by Alternative A and Alternative D. The preliminary benefit to cost ratio (BCR) for Alternative C is equal to 1.63 to 1 with annualized net benefits of approximately $23,000,000. For Alternative A the BCR is 1.48 and for Alternative D it is 1.28 with net benefits of $19,400,000 and $13,200,000, respectively.

Hydrologic information is limited, so estimates were not developed to evaluate the number of environmental structures that would be required for the alternatives. The inclusion of environmental structures could greatly increase the cost of Alternative D, which encloses 79 square miles of wetlands, in comparison to Alternative A (5 square miles) and Alternative C (15 square miles). Benefits such as reductions in emergency costs and damage to roadways have not been calculated and would expect to be greatest for Alternative D and the least for Alternative A. These benefits are usually minimal and would not impact the selection of the TSP.

Alternative A tracks the wetland-non-wetland interface in Laplace to its termination at the Hope Canal in western St. John the Baptist Parish. It requires the largest number of pump stations (8 pump stations) compared to Alternative C (4 pump stations) and would require approximately $7,500,000 in OMRR&R cost to maintain the fully constructed alternative compared to $4,100,000 in OMRR&R for Alternative C. If overtopped, Alternative A would allow immediate inundation at developed areas and I-10, resulting in the greatest residual risk.

3.8 Identifying the Tentatively Selected Plan

Alternative C is the tentatively selected plan (TSP) and the NED plan as determined by the evaluation criteria. It fulfills the planning objectives stated in Section 1.5. It reasonably maximizes net benefits, consistent with protecting the Nation's environment in accordance with national environmental statutes, applicable Executive Orders, and other Federal planning requirements.

4.0 ENVIRONMENTAL CONSEQUENCES (*NEPA Required)

This chapter describes the direct, indirect and cumulative environmental consequences of implementing the proposed hurricane and storm damage risk reduction plans considered in this study. Topics in this chapter mirror the topics in Chapter 2. The potential impacts (effects) of the alternatives in the Final Alternative Array to significant resources are compared to the No Action Alternative (i.e., future without-project conditions).

4.1 Water Environment

4.1.1 Flow and Water Levels

<u>Alternative C</u>

Direct and Indirect Impacts: Structural measures would provide storm damage risk reduction for those areas with the greatest human development, including: Laplace and the immediately surrounding area of St. John the Baptist Parish; and the town of Montz, in St. Charles Parish. This alternative would reduce the risk of flow and water levels in the interior of the protected levee and pump system during a storm surge. During such an event the levee system would be closed thereby causing interior (protected side) water stages and flows to decrease, while being similar for rainfall events. For the exterior (unprotected side), water stages during storm events along the east bank of St. James Parish and east bank of Ascension Parish could, to some unknown extent, potentially increase when the levee system is closed. Furthermore, the length of storm surge inundation to the exterior wetlands adjoining the proposed structurally protected areas could be less than under the No Action Alternative, as there could be less storm surge to drain from the interior with the proposed levee and associated features in place. Additional modeling will be conducted during the feasibility phase to determine if any such potential exists.

Of the 14,486 existing residential structures located in St. James Parish, an estimated 1,571 residential structures could be potentially elevated. However, there would likely be no effects to flows or water levels attributable to this measure in the St. James Parish area. The buy-out non-structural measure would also not significantly impact flows or water levels in the St. James Parish area. Although the green space created from structures removed following buy-outs, may have some minor effects to water flows.

Major indirect impacts of the structural measures would be a decrease in tidal interchange between the interior (protected side) and exterior (unprotected side) areas of the proposed levee alignment. Proposed modifications to the interior drainage system, required to mitigate for project-induced interior storm damage, would operate by gravity drainage, with pumps operating only during storm events resulting in high exterior water levels. It was estimated the pumps would be operated, on average, for 1.7 storm events per year which equates to closure of gate structures on average 8.5 days per year. Consequently, hydrologic connectivity would be generally maintained between the wetlands within the 47 square mile levee-enclosed area and the surrounding swamps and Lakes Maurepas and Pontchartrain except during the closing of the system for storm events. Preliminary hydrologic modeling (that does not include rainfall) indicates that future without-project daily water stages on the protected side would be similar to future with-project conditions except during storm events as described above.

Figure 4-1 displays the with and without project water elevations for both the exterior and interior sides of the levee system. Flows into and out of the system (not including rainfall) would also be similar to future without-project conditions, but there could be a brief time lag under the future with-project conditions. Figure 4-2 displays modeling simulation flows during the month of May for Area 5 near the Bonnet Carré. For this area, there was roughly ¾ the amount of interchange for with-project versus without-project. In addition, on average, there was a 10-minute delay in the timing of the tidal flows. Should the trend of increased precipitation and

climate warming continue, there could be continued increases in runoff associated with increased rainfall events which may affect the total volume of freshwater in the area as well as during storm damage peaks (USACE 2004). Non-structural measures would have little, if any, significant indirect impacts on flows or water levels.

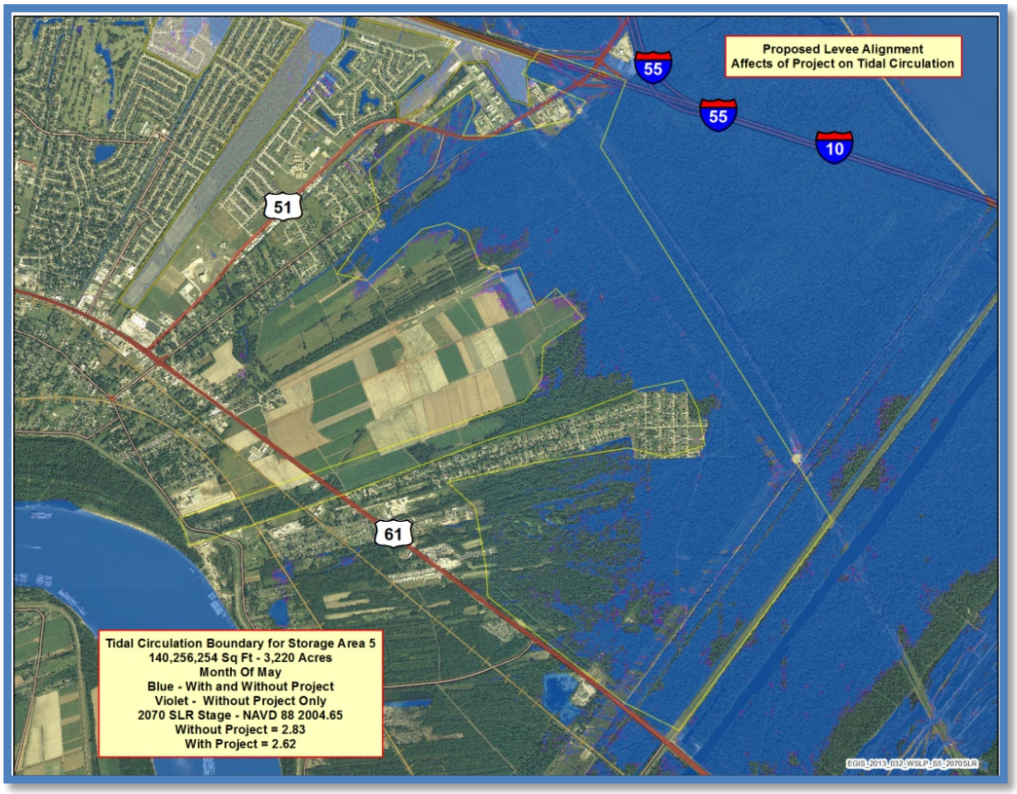


Figure 4-1: Model results of with and without proposed levee alignment affects on tidal circulation.

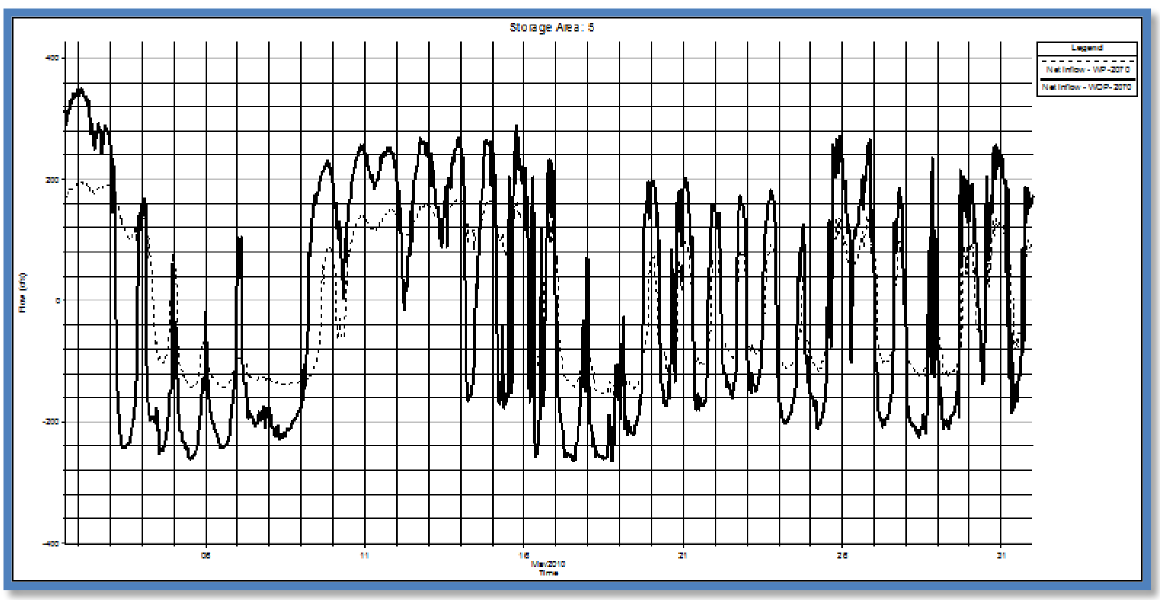


Figure 4-2: Modeling simulation flows during month of May for Area 5 (near Bonnet Carré guide levee).

Alternative C has the potential to increase stages to the areas exterior to the levee. These areas include the east bank of St. James Parish and the Gonzales and French Settlement areas in

Ascension Parish. Concern over induced flooding due to the Greater New Orleans Hurricane and Storm Damage Risk Reduction System (HSDRRS) caused similar concern after Hurricane Isaac to the Laplace area. However, based on ADCIRC studies after Hurricane Isaac induced flooding in Ascension Parish is not anticipated.

Cumulative Impacts: Impacts would be the incremental direct (856 acres) and indirect effects (up to 8,424 acres) on flows and water levels attributable to the proposed action in addition to the direct and indirect impacts to flow and water levels attributable of other previous, existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

Impacts in the Pontchartrain Basin levee systems, consistent with the USACE November 2012 preliminary report titled “Hurricane Isaac With and Without 100-year HSDRRS Evaluation” and the “Comprehensive Environmental Document, Phase I, Greater New Orleans HSDRRS”, (USACE 2013) include: approximately 217 miles of levees systems within the existing New Orleans HSDRRS; approximately 1,115 acres of recently constructed portions of the West Bank and Vicinity HSDRRS system; additionally the 142-mile long MR&T levee system and the 18-mile long non-Federal levee from Caernarvon to White Ditch; as well as potential impacts of projects approved for construction. The State levee systems include approximately 3,122 miles of levee. Approximately 100,000 miles of levees exist throughout the Nation (ASCE 2013).

<u>Alternative A</u>
Direct, Indirect and Cumulative Impacts: Impacts for structural measures would be similar to Alternative C, except they would occur over a smaller area (38 square miles enclosed area). Moreover, Alternative A has the potential to increase flood stages in the immediate areas exterior to the levee. However the affected area would be of a smaller footprint than the influence area of Alternative C. Direct, indirect and cumulative impacts of non-structural measures would be similar to those identified for Alternative C.

<u>Alternative D</u>
Direct Impacts: Impacts would be similar to Alternative C except over a much larger area (160 square miles) including the areas with the greatest human development within St. Charles and St. James and St. John the Baptist Parishes. The western-most portion of the Alternative D levee alignment would extend outside of the authorized project area into Ascension Parish to tie into an existing non-Federal levee. This alternative would directly impact flow and water levels in the interior (protected side) and exterior during rainfall and hurricane events. Interior water stages and flows would likely decrease for hurricane events, while being similar for rainfall events (assuming that the drainage structures or pumps are operating).

Indirect and Cumulative Impacts: Impacts would be similar to Alternative C, except over a larger area (160 square mile enclosed area) and the following exception: Alternative D would also have the potential to increase stages to the areas exterior to the proposed levee alignment. The probable affected area would be much larger than the influence area of Alternative C.

4.1.2 Sedimentation and Erosion

<u>Alternative C</u>
Direct and Indirect Impacts: Implementing the proposed action would require approximately 3,100,000 cubic yards of borrow sediments. However, best management practices would be used to avoid, minimize and reduce potential sedimentation and erosion impacts during borrow excavation. Construction of levees earthwork fill, placement of geotextile, T-walls, storm damage gates, drainage gates, sheetpile, riprap, gates and pumping stations would also utilize best construction management practices to avoid, minimize and reduce potential erosion and

sedimentation into adjacent wetlands. These impacts would generally be minor and short-term, lasting only during construction of the proposed project features. Indirect impacts would include significant reduction of erosion and sedimentation associated with storm events.

The placement of structures within waterways intersecting the levee alignment has the potential to create a sedimentation/erosion maintenance issue directly upstream and downstream of the structure. However, these structures would be designed and scour protection would be placed to minimize sedimentation/erosion issues. Several pumping stations would also be placed along the waterways that would intersect the levee alignment. These pump stations have the potential to cause severe erosion in the vicinity of the suction and discharge areas. The pump stations would be designed and scour protection would be placed to minimize sedimentation/erosion issues. Even as such, these issues may still exist. The proposed action has the potential to decrease tidal interchange velocities throughout the area resulting in increased sedimentation within waterways of both the interior and exterior of the proposed levee alignment.

Cumulative Impacts: Consist of the incremental direct and indirect impacts of implementing and operating the proposed hurricane and storm damage risk reduction system in addition to the direct and indirect impacts to sediment and erosion attributable to other existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

<u>Alternative A</u>
Direct, Indirect and Cumulative Impacts: Impacts would be similar to Alternative C except over a smaller area.

<u>Alternative D</u>
Direct, Indirect and Cumulative Impacts: Impacts would be similar to Alternative C except over a larger area.

4.1.3 Water Quality and Salinity

<u>Alternative C</u>
Direct and Indirect Impacts: Some wetland and open water areas would be converted into upland habitat for construction of hurricane protection features and would no longer provide water quality benefits. Because fill and construction materials are anticipated to be free of contaminants, discharge of these materials into existing adjacent waters is not expected to result in adverse effects to aquatic organisms. Construction impacts to runoff would be minimized through implementation of a Stormwater Pollution Prevention Plan (SWPPP) (USEPA 2012). Indirect impacts include water exchange between the flood and protected side of the levee system. This could lead to localized areas of stagnation and reduced salinity on the protected side of the levee and local areas of increased salinity on the flood side of the levee system. Additional development in areas behind the levee alignment could lead to additional point and nonpoint discharges within these areas. Structures operation is expected to impact biogeochemical cycling for wetlands within the proposed alignment. The project would provide for the protection of protected side wetlands, potentially extending their lifespan and their water quality functions. However, wetlands outside of the project are expected to experience an increase in wave energy and salinity, particularly during storm surge.

Cumulative Impacts: The proposed project, combined with other projects in the area, and activities could cumulatively impact water quality. Additionally, the combination of the proposed project and the several diversion projects could complicate water quality and hydrology, particularly for the protected side of the proposed alignment, leading to changes in wetlands biogeochemistry and water quality function. Cumulative impacts would be the incremental direct and indirect impacts of implementing and operating the proposed hurricane storm damage risk reduction system described above plus the direct and indirect impacts attributable to other existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

<u>Alternative A</u>
Direct, Indirect and Cumulative Impacts: The alignment of this alternative would minimize further impoundment of wetlands (3,564 acres as compared to 8,424 acres for Alternative C); hence, water quality impacts would be expected to be similar in nature, but less than, impacts associated with Alternative C.

<u>Alternative D</u>
Direct, Indirect and Cumulative Impacts: This alternative encloses the largest area by a significant margin (56,228 acres) while also having the greatest amount of new levee construction, water quality impacts associated with this alternative would be expected to be similar in nature but greater than impacts associated with Alternative C.

4.2 HUMAN ENVIRONMENT

4.2.1 Population and Housing

<u>Alternative C</u>
Direct and Indirect Impacts: Structural measures would have no direct impacts to population and housing. However, the non-structural measure of elevating residential structures would cause residents temporary and minor inconveniences related to relocating to a temporary residence and then returning to their elevated residence. Approximately 1,400 residences could be elevated in the Gramercy-Lutcher area. Non-structural acquisition of residential structures (buy out) could lead to a permanent loss of population and housing in the Gramercy/Lutcher area, if residents relocate outside the area. Indirect impacts for both the structural and non-structural features include reduced risk of hurricane storm surge damage to populations and housing. This would potentially enhance the stability and sustainability of population and housing resources behind the levee alignment. Elevating residential structures would affect access to elevated residences. Non-structural acquisition could lead to changes in population demographics, localized or on a larger scale. Non-structural acquisition could also lead to neighborhood housing interspersed with small to large areas of green space throughout the localized area. It is anticipated that local parish building codes would place restrictions on the elevation of future construction in the area where non-structural acquisition or raising in place is necessary. Implementation of the non-structural measure will be further developed and assessed during detailed feasibility-level design and provided in the final report.

Cumulative Impacts: Impacts would be the incremental direct and indirect impacts of implementing and operating the structural and non-structural measures of Alternative C on population and housing plus the direct and indirect impacts to by other previous, existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

<u>Alternative A</u>
Direct, Indirect and Cumulative Impacts: Impacts would be the same as Alternative C.

<u>Alternative D</u>
Direct, Indirect and Cumulative Impacts: Impacts would be the same as Alternative C, except non-structural measures would not be included.

4.2.2 Employment, Business and Industrial Activity (including Agriculture)

Alternative C

Direct and Indirect Impacts: Proposed structural measures would cause the Cajun Pride Swamp Tours temporary loss of access to the adjacent waterway until construction of boat access to the waterway is restored following construction of this reach of the project. The non-structural measures of raising non-residential structures could temporarily interrupt business operations as they are relocated to temporary locations. The acquisition of non-residential structures could lead to a permanent loss of employment and business activity in the Gramercy/Lutcher area where a total of 46 non-residential structures are being considered for elevation and 90 non-residential structures are being considered for acquisition by government. Indirect impacts for both the structural and non-structural features include reduced risk of damages from hurricane storm surge. It is anticipated that local parish building codes would place restrictions on the elevation of future construction in the area where non-structural acquisition or raising in place is necessary. If a business is elevated then access to the elevated facility could be more difficult and business operations could be more difficult to conduct. If a business is acquired there could be loss of jobs and a portion of the local tax base in the area. In contrast to the potential adverse effects to the St. James Parish area described above, the St. Charles and St. John the Baptist Parishes areas would generally benefit from implementation of the hurricane and storm surge damage risk reduction measures which would allow these businesses, industries and agricultural operations to continue to operate during storm events. Implementation of the non-structural measure will be further developed and assessed during detailed feasibility-level design and provided in the final report.

Cumulative Impacts: Impacts would be the incremental direct and indirect impacts of implementing the proposed action plus the direct and indirect impacts by other previous, existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

Alternative A

Direct, Indirect and Cumulative Impacts: Impacts would be the same as Alternative C.

Alternative D

Direct, Indirect and Cumulative Impacts: Impacts would be the same as Alternative C except all three parishes would be behind the levee alignment allowing for continued operation of businesses, industries and agriculture in St. James Parish during a storm surge event.

4.2.3 Public Facilities and Services

Alternative C

Direct and Indirect Impacts: Structural measures would not directly impact public facilities or services. However, non-structural measures of elevating public facilities would temporarily interrupt these services and inconvenience users until the facility is raised. Acquisition of public facilities could lead to relocation and/or a localized loss of public services in the Gramercy/Lutcher area. Indirect impacts for both the structural and non-structural features would include reduced risk of damage from hurricane storm surge for public facilities and services. In the event that a public facility is elevated, design will be such that the facility will be compliant with the requirements of the Americans With Disabilities Act. If it is necessary to acquire a public facility, it is likely that the facility will be substituted; however, it is likely that there could be temporary disruption of services. Implementation of the non-structural measure will be further developed and assessed during detailed feasibility-level design and provided in the final report.

Cumulative Impacts: Cumulative impacts would be the above described incremental direct and indirect impacts on public facilities and services. It includes the direct and indirect impacts to public facilities and services by other previous, existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

Alternative A
Direct, Indirect and Cumulative Impacts: Impacts would be the same as Alternative C.

Alternative D
Direct, Indirect and Cumulative Impacts: Impacts would be the same as Alternative C except for the absence of the indirect impacts associated with non-structural measures in the Gramercy/Lutcher area.

4.2.4 Transportation

Alternative C
Direct and Indirect Impacts: There would be no significant direct impacts. Rather, there would be minor temporary impacts in the form of increased vehicular congestion along roads, highways and streets during construction which cease following completion of construction activities. There would also be a degradation of the transportation infrastructure, primarily local roads and highways, as a result of the wear and tear from transporting construction materials. Indirect impacts would include a lower risk of storm damage-related damages to the transportation infrastructure for areas behind the proposed levee alignment.

Cumulative Impacts: Impacts would be the incremental direct and indirect impacts of implementing and operating Alternative C plus the direct and indirect impacts by other previous, existing and authorized levee systems within the Pontchartrain Basin, the State and the Nation.

Alternative A
Direct, Indirect and Cumulative Impacts: Impacts would be the same as Alternative C.

Alternative D
Direct and Indirect Impacts: Direct impacts would be similar to Alternative C, except construction impacts, such as traffic congestion and deterioration of the transportation infrastructure, could affect a total of 28 miles of roads. Indirect impacts would be similar to Alternative C, except risk reduction from storm damages transportation infrastructure would extend into the western portion of the area. This alternative could reduce the risk of inundation to a ground level section of I-10 in the western portion of the area which could improve access for emergency responders and prevent delays of local and regional residents returning to residences after storm events.

Cumulative Impacts: Impacts would be similar to Alternative C, except storm surge risk reduction to the transportation infrastructure would extend into the western portion of the project area. These would be in addition to the direct and indirect impacts of other existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

4.2.5 Community and Regional Growth

Alternative C
Direct and Indirect Impacts: There would be no direct impacts of the structural measures or with the non-structural measures of elevating structures. In contrast, acquisition of residential and non-residential structures could lead to a permanent loss of population and business activity in the Gramercy/Lutcher area thereby negatively affecting the community and regional growth in this area. There are 1571 residential and 90 non-residential structures considered for elevating and/or acquisition by the government which may impact community and regional growth.

Indirect impacts for both the structural and non-structural features of the alternative include reduced hurricane storm damage risk reduction for communities thereby contributing to potential growth opportunities for communities in the three-parish area. The proposed action could enable community growth to occur as the lower incidence of storm sure damage allows communities to focus more on community-building activities rather than preparing for and recovering from storm surge events. Implementation of the non-structural measure will be further developed and assessed during detailed feasibility-level design and provided in the final report.

Cumulative Impacts: Impacts would be the incremental direct and indirect impacts of implementing Alternative C on community and regional growth in addition to the direct and indirect impacts of other existing and authorized levees in the Pontchartrain Basin, the State and the Nation.

Alternative A
Direct, Indirect and Cumulative Impacts: Impacts would be the same as Alternative C.

Alternative D
Direct and Indirect Impacts: Direct impacts would include structural hurricane and storm surge damage risk reduction affecting community and regional growth for not only the St. Charles and St. John the Baptist Parishes, but also St. James Parish. Indirect impacts would be similar to Alternative C except over a three-parish area.

Cumulative Impacts: Impacts would be similar to Alternative C, except nonstructural measures would not be necessary in the Gramercy/Lutcher area. These incremental impacts would be in addition to the direct and indirect impacts to community and regional growth of other existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

4.2.6 Tax Revenues and Property Values
Alternative C
Direct and Indirect Impacts: Property values near levee construction sites may decrease temporarily due to added traffic congestion and construction noise and dust. These impacts would be temporary and minor, lasting only during construction. It is unknown at this time if elevating structures would have any effects on property values. However, acquisition of properties could reduce tax revenues and property values. Currently, there are 1400 residential and 90 non-residential structures being considered for elevating and/or acquisition by the government. Implementation of the non-structural measure will be further developed and assessed during detailed feasibility-level design and provided in the final report. Implementation of the non-structural measure will be further developed and assessed during detailed feasibility-level design and provided in the final report.

Indirect impacts could include increases in tax revenues and property values due to the increased hurricane storm damage risk reduction for residential properties and businesses. Indirect impacts of non-structural measure of acquisition could result in a decrease in tax revenue and property values because they would be converted to green space.

Cumulative Impacts: Impacts would be the above described incremental direct and indirect impacts of implementing and operating Alternative C in addition to the direct and indirect impacts to tax revenues and property values by other previous, existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

Alternative A
Direct Impacts: Impacts would be the same as Alternative C. Construction would be closer to development than Alternative C, thereby creating a greater chance of temporarily decreasing property values due to added traffic congestion, noise and dust during the construction.

Indirect and Cumulative Impacts: Impacts would be the same as Alternative C.

Alternative D
Direct Impacts: Direct impacts would include structural hurricane and storm surge damage risk reduction affecting tax revenues and property values not only for the St. Charles and St. John the Baptist Parishes, but also St. James Parish. Indirect impacts would be similar to Alternative C except over a three-parish area.

Indirect and Cumulative Impacts: Impacts would be the same as Alternative C.

4.2.7 Community Cohesion

Alternative C
Direct and Indirect Impacts: There would be no direct impacts from the structural measures. However, if residential structures are elevated then the residents would be temporarily relocated and community cohesion would be disrupted during the time the structures are being elevated. The acquisition of residential and non-residential structures could lead to a permanent loss of populations and business activities in the Gramercy/Lutcher area. This would have a negative impact on community cohesion in the area. Currently, there are 90 non-residential structures being considered for acquisition by government. Indirect impacts for both the structural and non-structural features include reduced storm damage risk for communities from the hurricane and storm surge damages, thus preserving the spatial patterns of social interaction and maintaining community cohesion. Non-structural measures may affect community cohesion in some localized areas in the St. James Parish area, especially with regard to acquisition. Implementation of the non-structural measure will be further developed and assessed during detailed feasibility-level design and provided in the final report.

Cumulative Impacts: Impacts would be the above described incremental direct and indirect impacts of implementing and operating Alternative C in addition to the direct and indirect impacts to community cohesion by other previous, existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

Alternative A
Direct, Indirect and Cumulative Impacts: Impacts would be the same as Alternative C.

Alternative D
Direct and Indirect Impacts: Direct impacts would include structural hurricane and storm surge damage risk reduction for the St. Charles, St. John the Baptist and St. James Parishes. Direct and indirect impacts associated with non-structural measures would not be present under this alternative.

Cumulative Impacts: Impacts would be similar to Alternative C, except nonstructural measures for the Gramercy/Lutcher area are not included in this alternative. These incremental impacts would be in addition to the direct and indirect impacts of other existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

4.2.8 Environmental Justice

Alternative C

Direct and Indirect Impacts: Discussion on the plan formulation and economic feasibility of screening alternatives can be found in Appendix D and Appendix E. During screening and optimization it was determined that it would not be economically justified to extend Alternative C into St. James Parish or to create a ring levee to address limited damages. Incorporating non-structural measures into Alternative C allows for an equal level of storm surge risk reduction across the three-parish area. Those properties eligible for acquisition may have an impact on the economic base found within these communities by removing portions of the population that contribute to the local economy. This may contribute to changes not only in community cohesion but also a potential collapse of the entire local community.

Despite existing base floor elevations differing among individual structures, structure-raising would provide the same level of risk reduction benefits per structure at year 2070 (end of the period of analysis). The costs of structure-raising would not be borne by any single individual or the community; rather, these costs would be part of the proposed project costs. Alternative C would provide additional safety to life, health and properties of residents and businesses within the study area by allowing storm water to first accumulate in a wetland area before potentially, in a worst case scenario, impacting structures. Drainage features and pumps included in this alternative would reduce this risk to residents.

Cumulative Impacts: Cumulative impacts would be the incremental direct and indirect impacts of implementing storm damage risk reduction measures on minority and low income populations in the area plus the direct and indirect impacts on minority and low income populations from hurricane storm damage risk management projects within the Pontchartrain Basin, the State and the Nation.

Alternative A

Direct, Indirect and Cumulative Impacts: Impacts would be the same as Alternative C.

Alternative D

Direct, Indirect and Cumulative Impacts: Alternative D extend structural measures for hurricane and storm damage risk reduction for all populations within the area removing the direct, indirect and cumulative impacts associated with the non-structural measures.

4.3 NATURAL ENVIRONMENT

4.3.1 Soils, Water bottoms and Prime and Unique Farmlands

Alternative C

Direct Impacts: A total of 856 acres, would be converted to levee, including 775 acres of primarily hydric soils of Cancienne and Fausse soils in St. Charles Parish; and Cancienne and Carville, Barbary, Schreiber and Gramercy soils in St. John the Baptist Parish (Table 4-1).

Approximately 14.8 acres of water bottoms in canals such as Reserve Flood Relief Canal and waterways such as the Mississippi Bayou would also be impacted. A total of approximately 55.4 acres of land classified as prime farmlands would be converted to nonagricultural use. Project impacts would be related to the construction of levee earthwork fill, geotextile, T-walls, storm damage gates, drainage gates, sheetpile, riprap, gates and pumping stations. The remaining project-induced impacts would be to existing developed areas such as highways and pipeline rights-of-way. The CEMVN has coordinated these potential impacts with the NRCS (Appendix A) and determined that the proposed conversion would be consistent with the Farmland Protection Policy Act and the USACE's internal policies. It is anticipated that the

Bonnet Carré government furnished borrow site has enough borrow material for the entire proposed action. Raising structures would have no direct impacts on soils or water bottoms; whereas, the acquisition of structures would result in soils returned to “green space” (i.e., structures, including slab foundations, would be removed from the area).

Table 4-1: Soil associations directly impacted by alternative alignments.

Soil Association	Alternative A	Alternative C	Alternative D
Cancienne and Carville soils (CR)	0.22 acres	-	0.22 acres
Levees-borrow pits (LV)	3.1 acres	3.6 acres	3.6 acres
Cancienne silty clay loam (Cn)	6.7 acres	18.7 acres	18.1 acres
Fausse clay (FA)	6.6 acres	14 acres	14 acres
Cancienne and Carville soils (CT)	143.8 acres	247.7 acres	239.6 acres
Barbary soils (Ba)	49.3 acres	451.5 acres	894.1 acres
Carville silt loam (CvA)	3.0 acres	-	-
Schriever clay (Sm)	129.5 acres	62.6 acres	-
Gramercy silty clay (GrA)	16.7 acres	35.1 acres	-
Schriever clay, 0 to 1 percent slopes (SkA)	32.8 acres	16.3 acres	-
Cancienne silt loam (CmA)	3.9 acres	10.7 acres	-
Cancienne silty clay loam (CnA)	6.4 acres	-	-

Indirect Impacts: Up to approximately 8,424 acres of hydric soils could be affected due to enclosing the area within the levee and pump system. The levee and pump system would be a gravity drainage system with pumps operated only during hurricane/tropical storm surge events of approximately 1.7 storm events per year and would be closed for approximately 8.5 days per year. Consequently, hydrologic connectivity would be generally maintained with the surrounding swamps and Lakes Maurepas and Pontchartrain, except during the closing of the system for hurricane/tropical storm surge events. Preliminary hydrologic modeling (not including rainfall) indicates that future with-project daily water stages on the protected side would be similar to future without-project conditions. In addition, future with-project flows into and out of the protected system (not including rainfall) would also be similar to future without project conditions, but there could be a brief time lag of approximately ten minutes (Section 4.1.1). The proposed action is not anticipated to convert any existing hydric or non-hydric soils, to a different soil type.

Cumulative Impacts: Cumulative impacts would be the incremental direct and indirect impacts of implementing Alternative C plus the direct and indirect impacts attributable to other previous, existing and authorized projects in the Pontchartrain Basin, the State and the Nation.

<u>Alternative A</u>

Direct and Indirect Impacts: Direct impacts would be similar to Alternative C with the following exceptions: a total footprint of 411 acres with direct impacts to approximately 376 acres of primarily hydric soils in St. John the Baptist Parish; impacts to Cancienne and Fausse soil associations in St. Charles Parish; and impacts of levee/structures construction to 7.8 acres of waterbottoms (Table 4-1). Additionally, approximately 53.4 acres of land classified as prime farmlands would be converted to nonagricultural use. Indirect impacts would be similar to Alternative C except Alternative A could indirectly affect up to 3,564 acres.

Cumulative Impacts: Cumulative impacts would be similar to Alternative C with the following exceptions: there would be an incremental total of about 411 acres of direct impacts and up to 3,564 acres of indirect impacts on soil resources and water bottoms; about 53.4 acres of farmlands converted to non-agricultural use; in addition to the direct and indirect impacts attributable to soils, water bottoms and prime and unique farmlands attributable to other existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

<u>Alternative D</u>
Direct, Indirect and Cumulative Impacts: Direct impacts would be similar to Alternative C with the following exceptions: Alternative D, with a total footprint of 1,181 acres, would directly impact approximately 1,115 acres of primarily hydric soils of Cancienne and Fausse soils in St. Charles Parish; Cancienne and Carville, Barbary, Schriever and Gamercy soil associations in St. John the Baptist Parish; and Barbary soils in Ascension and St. James Parishes. Alternative D would also directly impact approximately 17.5 acres of water bottoms, including the Blind River and Mississippi Bayou. No prime or unique farmlands would be impacted. Indirect impacts would be similar to Alternative C except Alternative D could indirectly affect up to 56,228 acres. Cumulative impacts would be similar to Alternative C with the following exceptions: incremental direct impacts of approximately 1,115 acres of soil resources and 17.5 acres of water bottoms; and up to 56,228 acres of indirect impacts in addition to the direct and indirect impacts to soil resources, water bottoms and prime and unique farmlands attributable to other existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

4.3.2 Vegetation Resources
<u>Alternative C</u>
Direct Impacts: Alternative C would directly impact a total of approximately 719 acres of wetlands including primarily forested wetlands/swamp along the reach of the alignment located north of US-61, and approximately 55 acres of dry and/or wet BLH located along the reach of the alignment located south of US-61 (Table 4-2 and Figure 4-3).

Table 4-2: Direct impacts resulting in loss of vegetation resources.

Alternative and Habitat Type	Direct Impacts
Alternative C -- forested wetlands/swamp	719.16 acres
Alternative C -- dry and/or wet BLH	55.97 acres
Subtotal Alternative C -- wetlands impacted	775.13 acres
Alternative C – non-wetlands	80.87 acres
TOTAL ALTERNATIVE C	856 acres
Alternative A -- forested wetlands/swamp	358.26 acres
Alternative A -- dry and/or wet BLH)	18.29 acres
Subtotal Alternative A -- wetlands impacted	376.55 acres
Alternative A -- non-wetlands	34.45 acres
TOTAL ALTERNATIVE A	411 acres
Alternative D -- forested wetlands/swamp	1,115.08 acres
Alternative D – non-wetlands	65.92 acres
TOTAL ALTERNATIVE D	1,181 acres

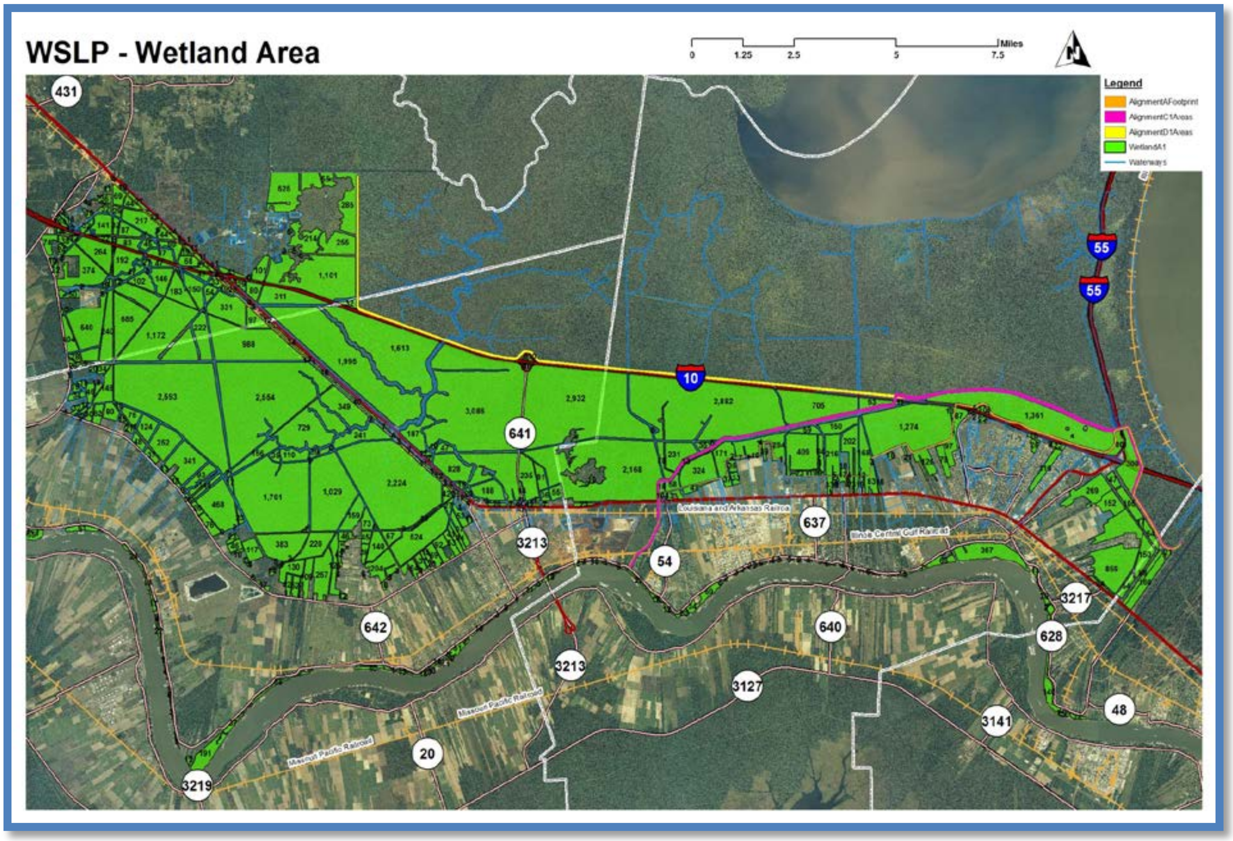


Figure 4-3: Wetland areas within each alternative in the final alternative array.

At this stage of the study, we have yet to conduct a traditional habitat impact analysis using the Wetland Value Assessment (WVA) methodology. In an effort to assess the scope of potential habitat impacts associated with the various alternatives, project-induced impacts to habitats were preliminarily determined utilizing existing information about the area from the Coastwide Reference Monitoring System (CRMS).

In order to assess the impacts of the alternative alignments on the habitat, data was obtained from the CRMS Site Level Report Cards for sites CRMS0059, CRMS5373, CRMS0039, CRMS5167 and CRMS0065 which are most applicable to the project location. In these reports three indices have been developed: a floristic quality (FQI), hydrologic (HI) and submergence vulnerability (SVI).

To assess the proposed levee alignment habitat impacts, data was obtained from the CRMS Site Level Report Cards for sites CRMS0059, CRMS5373, CRMS0039, CRMS5167 and CRMS0065; which are most applicable to the project location. These reports present three indices: floristic quality (FQI), hydrologic (HI) and submergence vulnerability (SVI). CRMS Analytical Teams, made up of agency and academic personnel, developed these indices based on the suite of parameters available from the 2006 to 2009 CRMS dataset.

The Floristic Quality Index (FQI) is used throughout the world to determine wetland quality based on plant species composition for a geographic area of interest. The FQI developed with the CRMS data is specific to coastal Louisiana. FQI scores from 0 to 100 are calculated for a sampling station and are based on the percent cover values and the Coefficient of Conservatism (CC score) of the species present (Cretini et al. 2012). The Hydrologic Index (HI) jointly assesses the suitability of two critical aspects of wetland hydrology, average salinity and percent time storm damaged, in maximizing vegetation primary productivity. The HI score (between 0 and 100) corresponds to the percent of maximum vegetation productivity expected to occur if the separate effects of salinity and inundation interact in a multiplicative fashion on vegetation productivity (Snedden and Swenson 2012). Submergence Vulnerability Index (SVI) scores are currently unavailable for the five CRMS sites listed above because the data collection thresholds for wetland elevation change and vertical accretion have not been met (Personal communication, Sarai Piazza, USGS, May 9, 2013).

Based on proximity of CRMS site locations to proposed alternative alignments, a combination of site CRMS0059 and CRMS5373 was utilized for analyzing habitat impacts of Alternatives A and C (TSP). All identified CRMS sites in the area were used for analyzing Alternative D. The FQI of each site by alternative were combined to obtain an average, and then converted the Index number into 0.1 to 1.0 range. The same process was utilized for determining the HI. Unfortunately the HI was unavailable for sites CRMS0059 and CRMS0065 because those sites did not meet salinity and/or water level data completeness threshold (70 percent per water year) in order to calculate an HI score. Next the FQI and HI (0.1-1.0) numbers were averaged to obtain a single number to apply for habitat quality for each alternative. Note that the FQI is calculated on herbaceous vegetation. The CRMS Analytical Teams have developed a Forested FQI that accounts for trees; however, it is still undergoing peer review. Though the Forested FQI would have been preferred, the herbaceous FQI is still useful as a comparison evaluation between alternatives.

The results of this analysis are presented in Table 4-3 and Table 4-4**.** Alternative C and Alternative A had the same average FQI, which was greater than Alternative D. This analysis also indicates that Alternative C and Alternative A would be equivalent with regard to the FQI used throughout the world to determine wetland quality based on herbaceous plant species composition. Alternatives C (TSP) and Alternative A had the same average combined HI (i.e., vegetation primary productivity) and FQI which was greater than Alternative D. These results indicate that the habitat quality for both Alternative C and Alternative A project areas are equivalent and greater than the habitat quality in Alternative D project area. The FQI score for each of the final array of alternatives was compared to both the Pontchartrain Basin Scale and Coastwide Scale FQI scores of 2006 through 2012.

Table 4-3: Average FQI, minimum and maximum FQI, and FQI converted to values between 0.1 – 1.0 for each alternative in the final alternative array.

Alternative	Average FQI	Minimum FQI	Maximum FQI	Average converted FQI
Alternative A and C	19.78592	16.12832	23.44351	0.197859
Alternative D	18.45094	14.13925	22.76262	0.184509

Table 4-4: HI, FQI, and average of the combination of HI and FQI for each alternative in the final alternative array.

Alternative	HI	FQI	Average of HI + FQI
Alternative A and C	0.864	0.197859	0.53093
Alternative D	0.769285714	0.184509	0.476898

Although this approach is not ideal for developing habitat quality, given the expedited time line and available data, this approach, because it was data driven, was considered to be better than any other option available until detailed feasibility-level habitat analysis can be conducted. Eventually the CRMS Analytical Teams may develop formulas to combine these indices into a single number, which would be greatly used. Unfortunately, that method is not yet developed, so we decided to maintain a simplified approach in using averages. It is expected that once feasibility analysis is conducted on the Alternative C, an interagency team will conduct a full habitat evaluation using the Wetland Value Assessment (WVA) methodology.

Indirect Impacts: Alternative C could potentially indirectly impact up to approximately 8,424 acres of primarily forested wetlands/swamp habitats used by fish and wildlife for shelter, nesting, feeding, roosting, cover, nursery and other life requirements. This would include cypress-tupelo swamp, the bald eagle, alligator snapping turtles, osprey, paddlefish, manatee, swamp milkweed, floating antler fern and rooted spike-rush (LDWF 2013), listed species and rare, unique or imperiled vegetative communities in the project area. However, preliminary hydrologic modeling indicates that the project design would have minimal changes to flows or stages on either the protected or unprotected sides. To accomplish this, the proposed levee system designs would include culverts with sluice gates joining directly with each of the existing culverts under I-10. Similarly, culverts would be included within the levee system along those levee reaches presently open to the surrounding wetlands system in order to retain hydrologic connectivity between the protected and unprotected areas. These structures would only be closed on average for 1.7 storm events annually, or about 8.5 days annually.

Additional indirect impacts would be the potential prevention of saltwater intrusion into the levee-enclosed system when structures are closed for hurricane/tropical storm surge events. Gates, such as along the Reserve Relief Canal and levee culverts would be closed for hurricane/tropical storm surge events on average frequency of about 1.7 times per year; which would result in the closure of the levee system for an average duration of about 8.5 days per year. Closure of the levee system during these storm surge events would reduce minor salt water intrusion into wetland habitats enclosed by the levee system. This could provide some reduction of the potential ecological stresses associated with saltwater intrusion and could also help reduce the conversion of existing forested wetlands and swamps to marsh and open water habitats.

It is unknown at this stage of the study process how water levels within the enclosed system would be managed with regard to increased in RSLR. It is also unknown the magnitude of the potential for substantial additional indirect impacts to enclosed forested wetlands, swamp and fish and wildlife resources. Later phases of this study will analyze and determine the extent of potential indirect impacts due to operation of the alternatives.

Cumulative Impacts: Cumulative impacts would be the incremental direct (856 acres) and indirect (up to 8,424 acres) impacts of implementing and operating Alternative C on vegetation resources plus the direct and indirect impacts attributable to other previous, existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

<u>Alternative A</u>

Direct Impacts: Direct impacts would be similar to Alternative C with the following exceptions: of the total of 411 acres directly impacted, 358 acres of forested wetlands and swamp, 18 acres of BLH, for a total of approximately 376 acres of wetland vegetation would be directly impacted.

Indirect Impacts: Indirect impacts would be similar to Alternative C except 3,564 acres of forested wetlands and swamp habitat could be impacted.

Cumulative Impacts: Cumulative impacts would be similar to Alternative C with these exceptions: there would be an incremental total of 376 acres of direct impacts and up to

3,564 acres of indirect impacts plus the direct and indirect impacts attributable to other existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

Alternative D

Direct Impacts: Direct impacts would be similar to Alternative C with the following exceptions: approximately 1,115 acres of forested wetlands and swamp could be directly impacted.

Indirect Impacts: Indirect impacts would be similar to Alternative C except up to 56,228 acres could be impacted.

Cumulative Impacts: Cumulative impacts would be similar to Alternative C with the following exceptions: there would be an incremental total of 1,115 acres of direct impacts and up to 56,228 acres of indirect impacts plus the direct and indirect impacts attributable to other existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

4.3.3 Wildlife Resources

Alternative C

Direct and Indirect Impacts: Of the 856 acres impacted, approximately 775 acres are primarily forested wetlands and swamp habitats along the reach of the proposed alignment located north of US-61; and approximately 18.29 acres of dry and/or wet BLH are located along the reach of the alignment south of US-61. Up to approximately 8,424 acres of primarily forested wetlands/swamp wildlife habitats would be indirectly impacted. However, preliminary hydrologic modeling indicates the project design would have minimal changes to flows or stages on either the protected or unprotected sides. It is anticipated that during detailed feasibility-level design, the levee system hydrologic connectivity would be more fully designed and optimized to retain hydrologic connectivity between areas that are within and outside of the levee alignment.

Wildlife access into and out of the levee-enclosed system would not be significantly impacted as most wildlife are highly mobile. However, aquatic wildlife would be temporarily restricted from entering the project area on average about 8.5 days per year due to closure of the levee system during hurricane/tropical storm surge events. Closure of the levee system during these storm surge events would reduce minor salt water intrusion into wetland habitats enclosed by the levee system. This could provide some reduction of the potential ecological stresses associated with saltwater intrusion and could also help reduce the conversion of existing forested wetlands and swamps wildlife habitat to marsh and open water habitats thereby protecting enclosed cypress-tupelo swamp for continued wildlife use. This would be especially important as RSLR is projected to increase.

Cumulative Impacts: Cumulative impacts would be the incremental direct (856 acres) and indirect (up to 8,424 acres) impacts of implementing and operating Alternative C on wildlife resources plus the direct and indirect impacts to wildlife resources attributable to other previous, existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

Alternative A

Direct, Indirect and Cumulative Impacts: Direct impacts would be similar to Alternative C with the following exceptions: of the total of 411 acres directly impacted, approximately 358 acres of forested wetlands and swamp wildlife habitat and approximately 18 acres of BLH wildlife habitat, for a total of approximately 376 acres of wetland habitats, would be directly impacted. Indirect impacts would be similar to Alternative C except up to approximately 3,564 acres could be affected. Cumulative impacts would be similar to Alternative C with the following exceptions: there would be an incremental total of about 376 acres of wildlife habitats directly impacted and up to approximately 3,564 acres of indirect impacts on habitats utilized by wildlife resources, in addition to the direct and indirect impacts attributable to other existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

Alternative D

Direct, Indirect and Cumulative Impacts: Direct impacts would be similar to Alternative C with these exceptions: of the total of 1,181 acres directly impacted, approximately 1,115 acres of forested wetlands and swamp wildlife habitat would be directly impacted. Indirect impacts would be similar to Alternative C except that approximately 8,424 acres could be affected. Cumulative impacts would be similar to Alternative C with the following exceptions: there would be an incremental total of 1,115 acres of direct impacts to wildlife habitat and up to approximately 56,228 acres of indirect impacts and the direct and indirect impacts attributable to other existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

4.3.4 Aquatic and Fisheries Resources

Alternative C

Direct and Indirect Impacts: Approximately 719 acres of existing benthos swamp habitat would be converted into upland grass covered (levee) habitat. Sessile organisms would be buried during construction. Mobile species of fish, shellfish and other aquatic resources would either avoid the area during construction (fish) or be moved out of the way due to water displacement (plankton). Up to 8,424 acres of forested wetland and swamp habitats utilized by aquatic and fishery recourses could be indirectly impacted. However, preliminary hydrologic modeling indicates that the project design would have minimal changes to flows or stages on either the protected or unprotected sides. It is anticipated that during detailed feasibility-level design, the proposed levee system hydrologic connectivity would be more fully designed and optimized to retain hydrologic connectivity between areas that are within and outside of the levee alignment.

Aquatic organism access into and out of the proposed action area would be impacted; additional culverts may deter some species from swimming through those structures. Aquatic species would be temporarily restricted from entering the proposed action area on average about 8.5 days per year due to closing gates and culverts in preparation for storm surge. This impact could be significant for the catadromous American eel that needs the fresh water areas for development and access to the ocean for breeding. If the closures occur, when the elvers stage enter the swamps there would be a recruitment age class loss. For marine species the impact would not be significant because their movement into the area is less dependent on tidal action and stage of development. Fresh water species would breed in the enclosed area for the most part and would not be indirectly impacted by the closure.

Cumulative Impacts: Impacts would be the incremental direct (719 acres) and indirect (up to 8,424 acres) impacts of implementing Alternative C and impacts attributable to other previous, existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

Alternative A

Direct, Indirect and Cumulative Impacts: Direct impacts would be similar to Alternative C with the following exceptions: approximately 358 acres of benthos would be directly impacted. Indirect impacts would be similar to Alternative C except Alternative A would enclose approximately 3,564 acres of aquatic habitat; hence, there would likely be a less significant impact on the American eels. Cumulative impacts would be similar to Alternative C with the following exceptions: there would be an incremental total of about 358 acres of aquatic habitats directly impacted and up to about 3,564 acres of indirect impacts on these resources. These incremental impacts would be in addition to the direct and indirect impacts attributable to other existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

Alternative D

Direct, Indirect and Cumulative Impacts: Direct impacts would be greater than Alternative C because approximately 1,115 acres of benthos would be directly impacted. Indirect impacts would be greater than Alternative C. Approximately 56,228 acres of aquatic habitats would be enclosed in the levee system; hence, a greater significant impact on American eels. Cumulative impacts would be similar to Alternative C with these exceptions: there would be an incremental total of about 1,115 acres of aquatic habitats directly impacted and up to 56,228 acres of indirect impact on these resources plus the direct and indirect impacts attributable to other existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

4.3.5 Essential Fish Habitat (EFH)

Alternative C

Direct, Indirect and Cumulative Impacts: Alternative C would have no direct, indirect, or cumulative impacts on EFH since no EFH intersects the proposed alignment or the proposed enclosed area in the near term (Figure 2-7). Closure of the levee system during hurricane/tropical storm surge events would reduce minor salt water intrusion into wetland habitats in the proposed levee system. This could provide some reduction of the potential ecological stresses associated with saltwater intrusion and could also help reduce the conversion of existing forested wetlands and swamps to marsh and open water habitats (EFH). If operating plan changes close the levee system more often due to RSLR, then those impacts would have to be analyzed and documented in a future supplemental NEPA document. The incremental direct and indirect impacts would be in addition to the direct and indirect impacts to EFH attributable to previous, existing and authorized levee systems implemented in the Pontchartrain Basin, the State and the Nation.

Alternative A

Direct, Indirect and Cumulative Impacts: Impacts would be similar to Alternative C. There would be a lower risk that a change in operating plan, due to RSLR, would have an adverse impact on EFH because there would be fewer acres of forested wetlands and swamp habitat susceptible to habitat conversion which would be enclosed by Alternative A.

Alternative D

Direct and Indirect Impacts: There would be no direct impact to white shrimp EFH. There would be direct impacts to red drum EFH where the gate on Blind River is built. The soft bottom habitat, EFH red drum habitat, in the footprint would be permanently removed from use. There would be no indirect impact on white shrimp EFH. Indirect impacts to red fish EFH would occur. Red drum EFH areas located within the construction turbidity plume may not be usable during construction. However, this impact would be temporary. The EFH area of Blind River inside the proposed levee system could be slightly less accessible by red fish after the levee structure is in place. However, the intent of the tentative levee design is to allow for existing flows and cross sections and should not hinder red fish access.

Cumulative Impacts: Impacts would be similar to those of the future without-project conditions. Closure of the levee system during hurricane/tropical storm surge events would reduce minor salt water intrusion into wetland habitats enclosed by the levee system. This could provide some reduction of the potential ecological stresses associated with saltwater intrusion and could also help reduce the conversion of existing forested wetlands and swamps to open water EFH. It is unknown at this stage of the study process how water levels within the enclosed system would respond with regard to increased in RSLR. The magnitude of the potential for substantial additional indirect impacts to enclosed forested wetlands, swamp and EFH is also unknown. These incremental direct and indirect impacts would be in addition to the direct and indirect impacts to EFH attributable to previous, existing and authorized levee systems implemented in the Pontchartrain Basin, the State and the Nation.

4.3.6 Threatened and Endangered Species

<u>Alternative C</u>

Direct and Indirect Impacts: Based on review of existing data and preliminary field surveys, the CEMVN finds that implementation of the proposed action would have no effects on any known listed species or their critical habitat, Bald eagles or colonial nesting waterbirds. Alternative C would directly impact (destroy) the following acres of habitats potentially utilized by listed species, the bald eagle and colonial nesting waterbirds: a total of 856 acres with approximately 775 acres of primarily forested wetlands and swamp habitats along the reach of the proposed alignment located north of US-61; as well as the approximately 18.29 acres of dry and/or wet BLH along the reach of the alignment located south of US-61. Other, adjacent forested wetlands and swamp habitats are available for use by listed species, the Bald Eagle and colonial nesting waterbirds. Alternative C could potentially indirectly degrade up to approximately 8,424 acres of primarily forested wetlands/swamp habitats potentially utilized by listed species, the bald eagle and colonial nesting waterbirds. However, preliminary hydrologic modeling indicates that the project design would have minimal changes to flows or stages on either the protected or unprotected sides. It is anticipated that during detailed feasibility-level design, the proposed levee system hydrologic connectivity would be more fully designed and optimized to retain hydrologic connectivity between areas that are within and outside of the levee alignment.

Access into and out of the project area would not be significantly impacted for the bald eagle or colonial nesting waterbirds. Gulf sturgeon and the West Indian Manatee would be temporarily restricted from entering the proposed action area on average about 8.5 days per year due to closing gates and culverts in preparation for storm surge events.

To deter colonial nesting water birds from establishing active nesting colonies in the construction areas, a Nesting Prevention Plan would be developed, in coordination with the USFWS and LDWF. If measures to prevent colonial nesting bird populations are not successful in the area, construction-related activities that would occur within 1,000 feet of a colony could be restricted to the non-nesting period, which in this region generally extends from September 1 to February 15, depending on the species present. This restriction would likely pose significant problems to construction activity schedules. If wading bird nesting colonies become established in the area, the 1,000 foot buffer must be maintained unless coordination with the USFWS indicates that the buffer zone may be reduced based on the species present or an agreement is reached with USFWS that allows a modified process to be adopted.

Alternative C would have no effect on any of the listed species or their critical habitat, Bald Eagles or colonial nesting waterbirds. There are existing Bald Eagle nests in the area; however, based on information provided by USFWS, all nests are beyond 1,500 feet from the proposed project alignments. Two potentially active waterbird rookeries exist within 1,000 feet of the proposed alignments. Before construction the USFWS and CEMVN will survey the area to confirm if the rookeries are active or not. USFWS guidelines would be utilized during construction to avoid any impacts to above described species, if encountered.

Cumulative Impacts: Impacts would be the incremental direct (convert 856 acres to levee habitat) and indirect (enclose and change hydrologic exchange of up to 8,424 acres) impacts of implementing and operating Alternative C on forested wetlands and swamps and other less numerous habitats potentially utilized by listed species, the bald eagle and colonial nesting waterbirds. These incremental impacts would be in addition to the direct and indirect impacts to listed species, the bald eagle and colonial nesting waterbirds by other previous, existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

Alternative A

Direct, Indirect and Cumulative Impacts: Direct impacts would be similar to Alternative C with theses exceptions: of the total 411 acres directly impacted, approximately 358 acres are forested wetlands and swamp habitat and approximately 18 acres are BLH habitat; for a total of 376 acres of wetland habitats directly impacted (destroyed). Other, adjacent forested wetlands and swamp habitats are available for use by listed species, the bald eagle and colonial nesting waterbirds. Indirect impacts would be similar to Alternative C except up to 3,564 acres could potentially be indirectly impacted. The implementation of Alternative A would have no effect on any listed species or their critical habitat, Bald Eagles or colonial nesting waterbirds. Cumulative impacts would be similar to Alternative C with these exceptions: there would be an incremental total of about 376 acres of direct impacts and up to approximately 56,228 acres of indirect impacts to forested wetlands, swamps and other wetland habitats utilized by listed species, the bald eagle and colonial nesting waterbirds plus the direct and indirect impacts of other existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

Alternative D

Direct, Indirect and Cumulative Impacts: Direct impacts would be similar to Alternative C with the following exceptions: of the total 1,181 acres potentially impacted by implementation of Alternative D, approximately 1,115 acres of forested wetlands and swamp habitats potentially utilized by listed species, the Bald Eagle and colonial nesting waterbirds would be directly impacted. Indirect impacts would be similar to Alternative C except up to 56,228 acres could be potentially impacted. Cumulative impacts would be similar to Alternative C with these exceptions: there would be an incremental total of about 1,115 acres of direct impacts and up to about 56,228 acre of indirect impacts to forested wetlands, swamps and other wetlands potentially utilized by listed species, the bald eagle and colonial nesting waterbirds. These incremental project-induced impacts would be in addition to the direct and indirect impacts of other existing and authorized levees in the Pontchartrain Basin, the State and the Nation.

4.3.7 Cultural and Historic Resources

Alternative C

Direct and Indirect Impacts: With a total footprint of 856 acres, Alternative C has a chance to directly affect any recorded cultural resources or an unrecorded cultural resource that may exist within its footprint, or its borrow source or mitigation areas. Site 16SJB68 is located at the western end of Alternative C, and would require further investigation as to whether it may be adversely affected by construction of Alignment C (TSP). There are no other currently recorded cultural resources within the Alternative C footprint. A large portion of the Alignment C (TSP) footprint has been surveyed via inclusion in cultural resource surveys for other purposes with no cultural resources recorded or expected. Regardless, portions of Alignment C (TSP), especially those closes to waterways, do retain a likelihood to contain unrecorded cultural resources that could be damaged by the construction of Alignment C (TSP). Indirect impacts of Alignment C (TSP) would not be substantial. Known or unknown cultural resources on either side of the alignment could receive indirect impacts via hurricane/tropical storm surge damage events.

Cumulative Impacts: Cumulative impacts would be the incremental direct and indirect impacts of implementing Alternative C plus the direct and indirect impacts to cultural resources by other previous, existing and authorized levees in the Pontchartrain Basin, the State and the Nation.

Alternative A

Direct, Indirect and Cumulative Impacts: Direct impacts would be similar to Alternative C. Site 16SJB68 overlaps the western edge of Alignment A, and would require testing to determine if adverse impacts may occur to the resource by construction of Alternative A. There are no other currently recorded cultural resources within the Alternative A footprint. An alignment similar to Alignment A was surveyed for cultural resources in 2003 and found no cultural resources. Previously unsurveyed areas of Alignment A will need to be examined for potential cultural resources before construction. Cumulative impacts would be similar to Alternative C.

Alternative D

Direct, Indirect and Cumulative Impacts: Direct impacts would be similar to Alternative C with exception that Alternative D has a footprint of 1,181 acres. Alternative D does not directly intersect any recorded and known cultural resources. There are cultural resources recorded in close proximity. Alternative D crosses many natural waterways considered high potential areas for cultural resources. Indirect and cumulative impacts would be similar to Alternative C.

4.3.8 Aesthetics and Visual Resources

Alternative C

Direct Impacts: Alternative C footprint is wider than Alternatives A or D giving it a wider direct area of effect. Even with this wider footprint, direct impacts to visual resources would be minimal in residential and agricultural areas. Much of the levee system would be in areas that are screened by deep forest and swamp, or are remote and have minimal access. Residential areas near the levee construction may see increases in dust and noise levels during construction. This is a temporary impact and conditions should return to preconstruction levels after completion of the project. View sheds from I-10 may also be altered near the intersection with I-55 and further west where the proposed levee crosses under the interstate. Where once a natural landscape of water, marsh, or swamp could be seen, a green topped levee with a wide footprint and storm damage walls would now be seen. The proposed levee system intersects and crosses the Maurepas Swamp WMA boundaries. In those areas, access for recreation will be limited.

Indirect Impacts: The River Road Scenic Byway may see temporary impacts due to truck traffic and construction vehicles, but impacts would be minimal. Construction of the proposed levee system would most likely require a storm damage control gate or other structure across US-61. This could reduce the visual quality of the drive along the Byway. The affected area of wetlands south of the proposed levee system could be approximately 8,424 acres which could change the landscape of the region due to water channel and drainage way closures or redirections.

Cumulative Impacts: Hydrologic units and drainage throughout the area of effect would be dramatically changed due to the introduction or enlargement of a large levee system to the area. Existing canals and channels could be altered or closed, changing water flows and altering the landscape. Cumulative impacts would be the incremental direct and indirect impacts of implementing Alternative C on visual resources plus the direct and indirect impacts by other existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

Alternative A

Direct, Indirect and Cumulative Impacts: Direct impacts to the visual resources would be similar to those described under Alternative C except the footprint of Alternative A is smaller in size than that of Alternative C. Indirect impacts to the visual resources would be similar to those described under Alternative C. The affected wetlands would be much less than the TSP with only 3,564 acres of potential impacts. Cumulative impacts would be similar to Alternative C.

Alternative D

Direct, Indirect and Cumulative Impacts: Direct, indirect and cumulative impacts to resources would be similar to those for Alternative C with the exception of the Blind River, a designated Wild and Scenic River, longer levee and potential impacts to 56,228 acres of wetlands.

4.3.9 Recreation Resources

Alternative C

Direct Impacts: Approximately four miles of the levee is within the Maurepas Swamp WMA. Depending on levee designs, the WMA may be less accessible by land and water to recreation users. The LDWF boat launches at the Hope Canal and Reserve Relief Canal, Cajun Pride Swamp Tours, the I-55 launch and the I-10 launch; and a recreational camp within the levee alignment would be affected by the proposed action. Nonstructural measures impacts could include raising buildings, such as visitor and community centers; but would not include effects on outdoor facilities such as golf courses, swimming pools, tennis courts, boat launches, playgrounds, or ball fields. Facilities that are raised would benefit from the added protection. Buyouts of facilities may decrease recreational opportunities for the community.

Indirect Impacts: Recreationists may have less access to Maurepas Swamp WMA. Boat launches may be closed permanently, closed during construction, or relocated. People with recreational camps may not be able to access their camps. Impacts to boat launches and camps could be mitigated through compensation, relocation, or other appropriate measures.

Cumulative Impacts: Area diversion projects (LCA CBRD and the Maurepas Diversions) would provide fresh water and improve wetlands. The WSLP project could decrease salt water intrusion resulting from hurricane/tropical storm surge events, which would improve fish and wildlife habitat and increase opportunities for fresh water fishing and hunting. As levees are built, recreational access through canals and bayous would decrease, but recreational infrastructure would realize a reduction in risk of damage from hurricane/tropical storm surge events. These incremental direct and indirect impacts would be in addition to direct and indirect impacts to recreation resources attributable to other previous, existing and authorized levee systems in the Pontchartrain Basin, the State and the Nation.

Alternative A

Direct, Indirect and Cumulative Impacts: Direct impacts would be similar to Alternative C with the following exceptions. The LDWF Hope Canal boat launch 0.2 mile north of Alternative A would not be impacted. There would be impacts to waterway access to the Hope Canal rather than the launch itself. The levee alignment crosses the access road to a recreational camp and would block access to it. Indirect and cumulative impacts would be similar to Alternative C.

Alternative D

Direct, Indirect and Cumulative Impacts: Direct impacts would be similar to Alternative C except there would be an additional 16 miles of levee alignment impacts to the Maurepas Swamp WMA. This alternative would impact waterway access to the Hope Canal rather than the launch itself. Additionally, the alignment would block water access to the St. James Boat Club and the US-61 boat launch. Indirect impacts would be similar to Alternative C. Cumulative impacts would be similar to Alternative C; however this alternative would limit recreational access to the Maurepas Swamp WMA to a greater extent because of the greater length of the alignment.

4.3.10 Noise

Alternative C

Direct, Indirect and Cumulative Impacts: There would be temporary and localized increased noise levels related to construction. Most of the alignment is remote and unpopulated so noise would not affect any nearby communities. The area south of US-61 and in the general vicinity of the I-10/I-55 intersection is populated and may be impacted by construction noise. After construction, noise levels would return to pre-construction conditions. Construction equipment is limited in the level of noise that can be emitted. Institutional recognition of noise, such as the regulations for Occupational Noise Exposure (29 CFR §1910.95) under the Occupational Safety and Health Act of 1970, as amended, would continue. This mandates that noise levels emitted from construction equipment be below 90 dB for exposures of eight hours per day or more. Noise may cause some temporary and minor annoyance to residents adjacent to the proposed alignment south of US-61 and business customers and workers (e.g., Shell gasoline station and casino) near the intersection of I-10/I-55. However, the Occupational Noise Exposure (29 CFR §1910.95) under the Occupational Safety and Health Act of 1970, as amended, would continue. Local fish and wildlife species may relocate during construction. Noise effects are expected to be localized, temporary and minor. Administrative and/or engineering controls, determining and implementing appropriate buffer zones, and implementing construction activity windows, shall address these issues. Any cumulative impacts would be temporary and minor in nature.

<u>Alternative A</u>
Direct, Indirect and Cumulative Impacts: Direct, indirect and cumulative impacts would be similar to Alternative C except over a smaller area.

<u>Alternative D</u>
Direct, Indirect and Cumulative Impacts: Impacts would be similar to Alternative C except there would be no impacts to residents south of the I-10 or US Highway 61; and there would be greater temporary and minor impacts to fish and wildlife resources along the longer alignment.

Figure 4-4: Laplace, Louisiana after Hurricane Isaac.

5.0 TENTATIVELY SELECTED PLAN (*NEPA Required)

Alternative C is the Tentatively Selected Plan (TSP). Feasibility-level design will commence after the SMART Planning Agency Decision Milestone and will finish before a Final Report.

5.1 Description of the Tentatively Plan

The TSP is an 18.27-mile risk reduction system around the communities of Montz, Laplace, Reserve and Garyville with non-structural components in St. James Parish. The alignment of the TSP is shown in Figure 3-4. The risk of storm surge damage would be reduced for over 7,000 structures and four miles of I-10 located in the system. Inclusion of this segment of I-10 would help maintain a major emergency evacuation and re-entry route for residents of southeast Louisiana, including residents in the New Orleans metropolitan area. The TSP also includes non-structural measures for 1,571 structures in the communities of Gramercy, Lutcher and Grand Point that are located outside of the proposed levee system. It is estimated that these non-structural measures would include elevation of 1,481 structures and acquisition of 90 structures. Implementation of non-structural features will be developed in more detail during feasibility level of design and analysis during which time an economic analysis will be conducted based on economic reaches. In developing the plan, consideration with be given to community cohesion and the requirements of EO 12898.

The structural component of the system would consist of earthen levees, floodwalls (T-walls), floodgates, drainage structures and pump stations located along the alignment. The preliminary level of design, based on modeling for a 1 percent AEP storm event includes levee elevations that would range from +13.5 NAVD88 on the eastern reaches near the Bonnet Carré Spillway to +7.0 NAVD88 in the western portion of the project area. They would be constructed with 3:1 side slopes with a 10-foot crown width. Construction of levees would involve the placement of 3,100,000 cubic yards of compacted and uncompacted clay (borrow) material on top of 3,400,000 square yards of geotextile fabric. Approximately 26,124 cubic yards of aggregate limestone would be used to build a road on the levee crown. A conveyance canal at a depth of -10 ft. NAVD88 would be situated along the levee. Floodwalls would be located under the I-10/I-55 interchange and other areas where space is limited. Nine floodwall sections would span 5,304 linear feet over the length of the system. The system would include 2,080 feet of drainage gates, 288 feet of roadway gates, two railway gates, and thirty-six pipeline crossings. Four pump stations would be located along the alignment to ensure the project does not adversely impact local drainage. Design parameters will be further refined during feasibility level design and analysis which may result in changes to the design parameters; however the TSP is anticipated to reduce risk for at minimum a 1 percent AEP storm event but not exceed a 0.5 percent AEP storm event.

The TSP would maintain hydrologic connectivity to the extent practicable through the use of water control structures except during closure for hurricane and tropical storm surge events. When the system is closed, pumps would operate on average for 1.7 storm events per year, which equates to closure of structures on average 8.5 days per year.

The structural alignment would directly convert approximately 856 acres to uplands including approximately 775 acres of hydric soils, 14.8 acres of water bottoms and 55.4 acres of prime farmlands. Approximately 8,424 acres of wetlands could be indirectly impacted due to enclosing the project area within the levee system. Further investigation is required to determine if cultural resources are located within any part of the footprint. Additional environmental investigations will be performed during feasibility-level design and analysis.

The estimated cost of the TSP is $880,851,070. The BCR for the TSP is equal to 1.63 to 1 with annualized net benefits equal to approximately $23,000,000.

5.1.1 Real Estate Requirements

A Real Estate Plan (REP) describing the real estate requirements and costs for the project can be found in Appendix C. The REP was prepared with estimated right-of-way (ROW) requirements based on available information. The REP and real estate cost estimates will be revised during feasibility-level design and analysis.

The estimated cost of real estate acquisition for structural features is $3,283,000. The alignment follows State-owned land and the property of approximately 120 owners. A standard perpetual levee easement for approximately 856 acres will be acquired for the construction of levees and floodwalls. A non-standard perpetual underground piling easement will also be acquired for all floodwalls. A standard Drainage Ditch Easement would be acquired for the areas needed for the conveyance canal. Borrow material for this project would come from the Bonnet Carré Spillway which is owned in fee by the Federal Government or from alternative sources not yet identified. A standard temporary work area easement will be acquired for staging areas. Mitigation land will be acquired in fee, excluding rights to minerals (with restrictions on use of surface). A non-material deviation will be made to the standard road easement to revise the rights necessary for a temporary non-exclusive road access (Appendix C).

The estimated cost of real estate acquisition for the non-structural feature is $81,417,000. Approximately 1,571 landowners may be impacted by this feature. The feature entails property acquisitions and structure raisings. At this time there has not been sufficient evaluation to determine particular structures to be included in the feature. A detailed evaluation of the work entailed in structure raising will be accomplished during the feasibility level design and analysis. At that time, the appropriate real estate interests to be acquired for non-structural measures will be determined, and the real estate costs will be refined. Displaced persons and businesses may be entitled to Public Law 91-646, Title II Relocations Assistance.

The total estimated cost of real estate for the project is $84,700,000. The CPRAB will have the responsibility of acquiring all necessary real estate interests for the project.

5.1.2 Relocation Assistance

Levee construction may cause relocations and/or temporary interruptions to pipelines. The existing carrier line would remain in operation while a bypass line would be constructed through a sleeve in the T-wall cutoff piles. When a bypass is complete and in place, the tie-in with the existing line would follow. Potential cost of this work is presented in Table 5-1. Detailed information will be developed during feasibility-level design and analysis.

Table 5-1: Unit cost of pipeline relocations.

Description	Estimated Quantity	Cost
≤6" Diameter	14	$515,000 each
>6" to ≤12" Diameter	16	$700,000 each
>18" to ≤24" Diameter	5	$1,550,000 each
> 24" Diameter	1	$1,920,000 each

5.1.3 Operation and Maintenance, Repair, Rehabilitation and Replacement

The purpose of operation and maintenance, repair, rehabilitation and replacement (OMRR&R) is to sustain the constructed project. The estimated annual OMRR&R cost is $4,128,075 (Table 3-4). This estimate will be further refined during feasibility-level design and analysis. After the

District Engineer provides notice of construction completion for the project, or functional portion of the project, the CPRAB will commence OMRR&R responsibilities associated with the project.

5.1.4 Benefit Analysis

Project Benefits

Models were run to determine the effects of storms on area resources. Hydrologic modeling results were developed to help establish the existing and future conditions and determine potential measures needed to address surge and storm-related damages. A database of values, types, and first floor elevations was developed for all structures in the area. This information was compared to the surge modeling to determine storm damages. Maps showing inundation of structures that could be damaged under FWP conditions will be developed.

Mitigation Plan Benefits

Habitat value analysis will be completed during feasibility-level design and analysis. Ecological model results will be combined with cost data to develop mitigation plans.

5.1.5 Risk & Uncertainty Analysis

Risk and uncertainty are intrinsic in water resources planning and design. This section describes various categories of risk and uncertainty pertinent to the study. Risk and uncertainty will be further considered during feasibility-level design and analysis.

5.1.5.1 Environmental Factors

Relative Sea Level Rise*:* There is uncertainty about how much sea level change (SLC) would occur in the region. Higher than estimated RSLR could cause salt water intrusion into the freshwater swamp causing significant changes to this habitat.

An assessment of RSLR was included in plan formulation and alternatives analysis. The evaluation of RSLR is documented in Appendix B and will be refined during feasibility level design and analysis. Calculations based on EC 1165-2-212 determined that the low, intermediate and high rates of RSLR at 2070 are 1.81 feet per year, 2.32 feet per year, and 3.95 feet per year, respectively (Table 2-2). The intermediate RSLR rate was applied.

RSLR could impact the benefits achieved by the TSP. Because the project was developed using the intermediate RSLR rate, the TSP would provide more benefits than anticipated should the low RSLR rate result and less benefits with the high RSLR rate. The non-structural component would be less effective because structures would have to be raised to a height that would increase their risk from wind damage during a storm.

Storms: Risks associated with the TSP are primarily related to the possibility of extreme weather events. The uncertainty of the size or frequency of storms and meteorological events, such as El Nino and La Nina, cannot be predicted over a set period of time. The storm record is constantly being updated and a large storm such as Hurricane Katrina or a slow moving storm such as Isaac can alter the expected return period for other storms. To reduce the uncertainties of storm events, storms with varying degrees of size, intensity, and path are included in the modeling. By using a long-term record of different storm scenarios, the effects of such storms are incorporated into the modeling. The team is then able to reduce the uncertainty in the determination of project benefits (Appendix B).

5.1.5.2 Engineering Factors

Levee/Structure Failure: The risk associated with the levee/structure system is its stability. Analysis of the earthen levee and associated T-walls and gates will be evaluated during feasibility-level design and analysis, and included in Appendix B. The levee and other features will be constructed to meet USACE standards.

Hydrologic Flows: There is uncertainty as to whether the levee system would potentially induce flooding internally and externally to the levee alignment. Modeling results will be analyzed during feasibility level design and included in the final report. Hydrologic modeling (ADCIRC and STWAVE) will show if the TSP could potentially induce flooding in these area and allow for more accurate engineering and design of the levee system. The project will incorporate features to mitigate for any potential induced flooding.

The risk of running the ADCIRC and STWAVE models is the assumption that the models appear to provide a specific response on the TSP in any given scenario; however it is only a representative point of reference in a complex system. While the analysis is enhanced by the models, application of the models can introduce error and uncertainty. Calibration and verification efforts are employed so that the models more closely replicate observed changes or at least provide insight into the limitations of the model.

Models are limited by basic, underlying assumptions and uncertainties. Some of the simplifying assumptions include the model parameters. A sensitivity discussion will be completed during feasibility-level design and analysis and included in Appendix B of the final report. Another uncertainty is that a limited number of storm scenarios are modeled. It is assumed that various storm scenarios over a number of years will represent a much higher indicator of the levees ability to withstand major storm events.

The models also use available historic data to extrapolate future storm conditions and frequency. The size and frequency of storms included in the model are based on statistical analysis but do not account for meteorological changes, such El Nino and La Nina effects, that can increase or decrease storms over a period of several years. Neither do the models account for the potential of increased storms due to climate change.

5.1.5.3 Economic Factors

The risk for economics is in under or overestimating the future benefits associated with the project alternatives. The with-project damages and overall benefits associated with the alternatives were estimated based on the existing and future without-project damages. This could potentially result in the TSP not being economically justified or preliminary estimates of the benefit cost ratios being overstated. A full economic analysis will be conducted during feasibly level design and documented in the final report. Additional uncertainty surrounding variables such as population growth, first floor elevations, structure value, depth damage relationships and additional inputs are consistent with typically accepted project uncertainty.

The Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA) Version 1.2.5a certified model was used to calculate the damages for the without project existing and future conditions. Economic and engineering inputs were necessary for the model to calculate damages for existing conditions (2012), the project base year (2020) and the final year in the period of analysis (2070). The inputs included structure inventory, future development, contents-to-structure value ratios, vehicles, first floor elevations and depth-damage relationships, ground elevations and without-project stage probability relationships.

The uncertainty surrounding each of the economic and engineering variables was entered into the model. Either a normal probability distribution, with a mean value and a standard deviation, or a triangular probability distribution, with a most likely, a maximum and a minimum value, was entered into the model to quantify the uncertainty associated with the key economic variables. A normal probability distribution was entered into the model to quantify the uncertainty surrounding the ground elevations. The number of years that stages were recorded at a given gage was entered for each study area reach to quantify the hydrologic uncertainty or error surrounding the stage-probability relationships.

5.1.5.4 Implementation Factors

Non-structural costs were based on a 100% structural survey of area improvements. Structures located in the 2020 and 2070 100-year floodplains were evaluated by comparing the cost of elevating the structure to the cost of acquiring the structure. The greater cost was used to determine an estimate of the cost of the non-structural feature. Relative sea level rise greatly impacts the number of structures to be raised, resulting in uncertainty as to how many structures would have to be raised. A minimum cost of the non-structural feature of $53,143,789 was developed based on the cost of reducing risk to structures in the 2020 100-year floodplain. A maximum cost of $305,256,794 was developed based on the cost of reducing risk to structures in the 2070 100-year floodplain. During feasibility level of design, the non-structural feature will be further evaluated by economic reach. The resulting evaluation may reduce the number of structures that would be included in the non-structural feature.

5.2 Implementation Requirements

5.2.1 Preconstruction Engineering and Design

Detailed design of the WSLP Project will be shared between CPRAB and the USACE. All detailed design will be in accordance with USACE's regulations and standards.

5.2.2 Construction and LERRD

Construction would be in accordance with the USACE's regulations and standards. Lands, easements, right-of-ways, relocations and disposal areas (LERRD) would be the responsibility of the CPRAB (Appendix C).

5.2.3 Cost Sharing

The State of Louisiana, acting through the PLD, is the non-Federal sponsor for the feasibility study. The cost-share during the feasibility phase is 50% Federal and 50% non-Federal. Following the feasibility phase, the CPRAB will be the non-Federal Sponsor for the planning, design, construction, operation, maintenance, repair, replacement and rehabilitation of the project. The cost share for the planning, design and construction of the project will be 65% Federal and 35% non-Federal. The CPRAB must provide all project LERRD required for the project. OMRR&R of the project would be a 100% CPRAB responsibility. A full description of the non-Federal and Federal responsibilities after the feasibility phase of the project is contained in Section 8.2 of this report. The OMRR&R costs are estimated to have a present value of $4,128,075 at 2012 price levels and include a 25% contingency. AM&M costs are not included in the estimate at this time; those costs will be included in the final report. Table 5-2 presents the cost apportionment.

Table 5-2: Cost apportionment of the TSP.

	Total	Federal	Non-Federal
PED	$7,500,000	$4,875,000	$2,625,000
Construction	$761,051,070	$557,500,446	$203,550,625
Pipeline Relocations	$35,100,000	-	$35,100,000
Lands, Easements, & ROW*	$84,700,000	$15,052,750	$69,647,250
Total First Costs**	**$888,351,070**	**$577,428,196**	**$310,922,875**

*** Federal costs are Administrative Cost of Non-Federal Sponsor Oversight**
**** Monitoring and Adaptive Management costs not included.**

5.3 Mitigation Plan

Although mitigation planning was integrated into the overall plan formulation process, implementation of the TSP requires compensatory mitigation for unavoidable project-induced impacts that will require replacing or providing substitute resources. A mitigation plan for the TSP will be completed following the feasibility level design and analysis and will be included in the final report. Additional information is located in Appendix A.

5.4 Adaptive Management & Monitoring

Incorporation of AM&M activities into the mitigation plan will address ecological and other uncertainties that could prevent successful implementation of mitigation project measures. The AM&M Plan will establish a framework for decision-making that utilizes monitoring results and other information, as it becomes available, to update project knowledge and adjust mitigation management actions through adaptive management. Integration of AM&M into the mitigation project will ensure success under a wide range of conditions and enable implementing corrective actions in cases where monitoring demonstrates that the mitigation project or measures are not achieving ecological success. An AM&M plan will be developed and included as part of the mitigation plan in the final report. Additional information is located in Appendix A.

5.5 Views of the Non-Federal Sponsor

The PLD and the CPRAB support and recognize the importance of hurricane risk reduction in St. Charles, St. John the Baptist and St. James Parishes. This study is included in the 2012 Louisiana Comprehensive Master Plan for a Sustainable Coast and is supported by the Louisiana Congressional delegation. The USACE has worked as a team along with an interagency team and local stakeholders to develop a feasible comprehensive plan that would provide hurricane storm surge risk reduction to the citizens in the area. Construction of the proposed system would immediately allow for improved storm surge risk reduction in the three-parish area, which could potentially reduce life, health and safety risk to residents and interruptions to vital hurricane evacuation routes.

Figure 5-1: St. James Parish flooding after Hurricane Isaac.

6.0 ENVIRONMENTAL LAWS & COMPLIANCE (*NEPA Required)

There are many Federal and state laws pertaining to the enhancement, management and protection of the environment. Federal projects must comply with environmental laws, regulations, policies, rules and guidance in Appendix A. The team coordinated with Federal and state resource agencies during planning and will continue to coordinate. Compliance with laws will be accomplished upon review of this report by appropriate agencies and the public, and with the signing of a Record of Decision by the Assistant Secretary of the Army for Civil Works.

6.1 Clean Air Act of 1972 (Air Quality)

The Clean Air Act (CAA) sets goals and standards for the quality and purity of air. It requires the Environmental Protection Agency to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The project area is in St. Charles, St. James and St. John the Baptist Parishes, which are currently in attainment of NAAQS. The Louisiana Department of Environmental Quality is not required by the CAA and Louisiana Administrative Code, Title 33 to grant a general conformity determination.

6.2 Clean Water Act of 1972 – Section 401 (Water Quality)

The Clean Water Act (CWA) sets and maintains goals and standards for water quality and purity. Section 401 requires a Water Quality Certification from the Louisiana Department of Environmental Quality that a proposed project does not violate established effluent limitations and water quality standards. Section 401 compliance will be documented in the final report.

6.3 Clean Water Act of 1972 – Section 404(b)(1) (Wetlands)

The USACE administers regulations under Section 404(b)(1) of the CWA, which establishes a program to regulate the discharge of dredged and fill material into waters of the U.S., including wetlands. Potential project-induced impacts subject to these regulations will be evaluated during feasibility level design. A completed 404(b)(1) evaluation will be included in the final report.

6.4 Coastal Zone Management Act of 1972 (Coastal Zone Development)

The Coastal Zone Management Act is a partnership structure allowing states and the Federal government to work together for the protection of U.S. coastal zones from environmentally harmful over-development. Potential project-induced impacts will be evaluated during feasibility level design. They will be described in a Consistency Determination that will be submitted to the Louisiana Department of Natural Resources to review for consistency with the Louisiana Coastal Resource Program. The determination and findings will be provided in the final report.

6.5 Endangered Species Act of 1973 (Threatened & Endangered Species)

The Endangered Species Act (ESA) is designed to protect and recover threatened and endangered (T&E) species of fish, wildlife and plants. The CEMVN is coordinating with the USFWS and the National Marine Fisheries Service (NMFS) to ensure for the protection of those T&E species under their respective jurisdictions. The USFWS identified in their January 9, 2009 coordination letter two T&E species, the Gulf sturgeon and the West Indian manatee, that are known to occur or occasionally occur in the project area. No plants were identified as being threatened or endangered in the project area. There are no T&E species or their critical habitat under NMFS jurisdiction located in the project area that would be impacted by the proposed action. Based on review of existing data and preliminary field surveys, the CEMVN finds that implementation of the TSP would have no effect on any listed species or their critical habitat.

6.6 Bald and Golden Eagle Protection Act of 1940 (Bald Eagles)

The Bald and Golden Eagle Protection Act protects two eagle species. Bald eagled occur or occasionally occur in the project area. Based on review of existing data and preliminary field surveys, the CEMVN finds that implementation of the TSP would have no effect on bald eagles.

6.7 Louisiana State Threatened and Endangered Species and Rare and Unique Habitat

The Louisiana Department of Wildlife and Fisheries (LDWF) Louisiana Natural Heritage Program (LNHP) lists T&E species, and rare, unique and imperiled habitats in the State of Louisiana. Based on review of the LNHP online database, rare or unique cypress-tupelo swamp habitat, bald eagles, alligator snapping turtles, osprey, paddlefish, manatees, swamp milkweed, floating antler fern and rooted spike-rush is found in the project area (LDWF 2013).

6.8 Colonial Nesting Water Birds

The USFWS indicated in their January 9, 2009 coordination letter that the project area is known to support colonial nesting water birds (e.g., herons, egrets, ibis, night-herons and roseate spoonbills). Based on review of existing data and preliminary field surveys, the CEMVN finds that implementation of the TSP would have no effect on colonial nesting water birds.

6.9 Farmland Protection Policy Act of 1981 (Farmland)

The Farmland Protection Policy Act (FPPA) is intended to minimize the impact of Federal programs on the unnecessary and irreversible conversion of farmland to nonagricultural uses. Projects are subject to requirements if they may irreversibly convert farmland to nonagricultural use and are completed by a Federal agency or with assistance from a Federal agency. In its review of the proposed project the NRCS determined that the TSP will impact 55.4 acres of prime or unique farmland and that the project will not impact NRCS work in the vicinity (June 8, 2013 email). No actions will be taken to avoid impacts to farmland.

6.10 Fish and Wildlife Coordination Act of 1934 (Fish & Wildlife)

The Fish and Wildlife Coordination Act (FWCA) provides authority for the USFWS involvement in evaluating impacts to fish and wildlife from proposed water resource development projects. It requires that fish and wildlife resources receive equal consideration to other project features. It requires Federal agencies that construct, license or permit water resource development projects to first consult with the USFWS, NMFS and state resource agencies regarding the impacts on fish and wildlife resources and measures to mitigate these impacts. Section 2(b) requires the USFWS to produce a Coordination Act Report (FWCAR) that details existing fish and wildlife resources in a project area, potential impacts due to a proposed project and recommendations for a project. The draft FWCAR includes the USFWS positions and recommendations. This draft document, CEMVN’s responses and coordination planning aid letters are found in Appendix A.

The USFWS, as part of their coordination efforts, provided a map depicting colonial nesting waterbird (e.g., herons, egrets, ibis, night-herons, and roseate spoonbills) rookeries within the area. Two potentially active rookeries may exist within 1,000 feet of the proposed alignment. USFWS and USACE biologists will survey the area before construction to confirm active rookery locations. If active rookeries exist within 1,000 feet of an alignment, this could be a project constraint. USFWS guidelines would be followed to avoid adverse impacts to these species.

A January 29, 2009, NMFS letter indicates that aquatic and wetland habitats in the area include estuarine emergent wetlands, submerged aquatic vegetation, mud substrates, and estuarine water column. These habitats provide EFH for white shrimp and red drum. Waterbodies and wetlands provide nursery and foraging habitats for a variety of fish species, some of which may serve as prey for other fish species designated as EFH species (e.g., mackerel, snapper, and grouper) and highly migratory fishes (e.g., billfish and sharks). The NMFS letter indicates the area provides foraging and nursery habitat for economically important marine fishery resources including striped mullet, Atlantic croaker, blue crab, and Gulf menhaden. In addition to providing habitat for species with designated EFH, the area is important for Federal and state-managed species. It provides foraging and nursery areas for prey species (gulf menhaden and bay anchovy) (Penland et al. 2002) eaten by predators, such as sand seatrout, spotted seatrout, catfish and crappie (LDWF 2009, Hastings 2001), and highly migratory species.

6.11 Magnuson-Stevens Fishery Conservation and Management Act of 1976 and The Magnuson-Stevens Act Reauthorization of 2006 (Essential Fish Habitat)

The law and its reauthorization govern marine fisheries management in the U.S. Essential Fish Habitat (EFH) does not intersect the proposed alignment or the enclosed area in the near term. The CEMVN has determined that the TSP would have no impacts to EFH.

6.12 Marine Mammal Protection Act of 1972 (Marine Mammals)

The Marine Mammal Protection Act (MMPA) protects whales, dolphins, sea lions, seals, manatees and other species of marine mammals. The CEMVN finds the TSP would have no effect on marine mammals that may occasionally be found in the project area. To avoid "takings" of the West Indian manatee and ensure compliance with the MMPA, the CEMVN commits that 1) all construction personnel will be educated about the MMPA, the ESA and the West Indian manatee, 2) a search for manatees in the project area and mitigation areas would be conducted before construction, and 3) appropriate best management practices to avoid or minimize potential entrapment of manatees during construction would be implemented.

6.13 Migratory Bird Treaty Act of 1918 and Migratory Bird Conservation Act of 1929 (Migratory Birds)

The Migratory Bird Treaty Act (MBTA) and the Migratory Bird Conservation Act (MBCA) protect migratory birds and their habitat. Many important habitats in the project area provide migratory bird shelter, nesting, feeding and roosting habitat. The TSP would potentially convert 719 acres of forested wetland/swamp habitat and 55 acres of dry and/or wet BLH habitat to levee. In addition, the TSP would enclose and potentially change hydrologic conditions of up to 8,424 acres of forested wetlands/swamp and BLH habitats. Implementation of the TSP will require compensatory mitigation for unavoidable project-induced impacts to bird and wildlife habitat.

6.14 National Historic Preservation Act of 1966 (Cultural and Historic Resources)

In compliance with Section 106 of the National Historic Preservation Act (NHPA) and 36 CFR §800, Federal agencies are required to identify and consider the potential effects that their undertakings might have on significant historic properties, district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. Additionally, a Federal agency shall consult with any tribe that attaches religious and cultural significance to such properties. Agencies shall afford the State Historic Preservation Officer (SHPO) and tribes a reasonable opportunity to comment before decisions are made. Any National Register eligible sites would be avoided to the maximum extent possible and any potential adverse effects would be mitigated. A variety of mitigation measures are possible, ranging from avoidance to data recovery to other types of documentation. Mitigation can take place at the site directly affected or can be concentrated at any one site. Decisions on mitigation strategies would be made under a Memorandum of Agreement among the CEMVN, the Louisiana SHPO and any consulting Indian tribes. Sites unevaluated for National Register eligibility would either have to be avoided or further research would be carried out in order to determine National Register eligibility.

The CEMVN has not yet presented a formal conclusion for cultural resources in coordination with the Louisiana SHPO and the Federally-recognized tribes. A letter presenting the alternatives discussed in this document and the research conducted thus far was mailed to the Louisiana SHPO on May 3, 2013. The CEMVN will continue Section 106 consultation and finalize assessment of previous studies and necessary further study during feasibility level design. Compliance with Section 106 will be documented in a final report.

6.14.1 Tribal Consultation (Tribal Interests)

In partial fulfillment of EO 13175 ("Consultation and Coordination With Indian Tribal Governments"), NEPA and Section 106, consultation was initiated with Federally-recognized Tribes: Alabama-Coushatta Tribe of Texas, Caddo Nation of Oklahoma, Chitimacha Tribe of Louisiana, Choctaw Nation of Oklahoma, Coushatta Tribe of Louisiana, Jena Band of Choctaw Indians, Mississippi Band of Choctaw Indians, Quapaw Tribe of Oklahoma, Seminole Nation of Oklahoma, Seminole Tribe of Florida and Tunica-Biloxi Tribe of Louisiana. In a May 3, 2013, letter, the CEMVN summarized the study authority and history of investigations, study area and proposed alignments, offering tribes the opportunity to review and comment on the potential of the proposed action to significantly affect protected tribal resources, tribal rights, or Indian lands. The CEMVN will consult with these tribes. Correspondence will be included in the final report.

6.15 Resource Conservation and Recovery Act of 1976, as amended by the Hazardous and Solid Waste Amendments of 1984

A Phase I Environmental Site Assessment (ESA) is required for all of the USACE Civil Works Projects, to facilitate early identification and appropriate consideration of potential Hazardous, Toxic, and Radioactive Waste (HTRW) problems. HTRW includes any material listed as a "Hazardous Substance" under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Other regulated contaminants include those substances that are not included under CERCLA but pose a potential health or safety hazard, and are regulated. Examples include, but are not limited to, many industrial wastes, naturally occurring radioactive materials (NORM), many products and wastes associated with the oil and gas industry, herbicides, and pesticides. Engineer Regulation ER 1165-2-132 and Division Regulation DIVR 1165-2-9 established policies for conducting HTRW review for USACE Civil Works Projects.

The area has a lot of undeveloped property, mostly wetlands. It contains numerous oil and gas wells, with associated waste pits, and pipelines (Figure 3-7). The area is heavily industrialized, mainly with facilities associated with oil, gas, and petrochemical production, including the Shell NORCO and Valero St. Charles refineries just outside the project area; there are other industrial facilities within the project area. All these industrial facilities have the potential to be chemical discharge sources, which can occur at unpredictable times. Alignments A, C, and D all have some potential Recognized Environmental Conditions (RECs) near or within the alignment, but no RECs have been identified at this time. The TSP will be analyzed during feasibility level project design and a standard Phase I Environmental Site Assessment will be prepared to identify potential RECs and to avoid areas that could contain substances of concern.

6.16 Wild and Scenic River Act of 1968 (Rivers)

The Wild and Scenic Rivers Act establishes a National Wild and Scenic Rivers System. The Louisiana Scenic Rivers Act recognizes and implements the 1968 Federal law, to preserve, protect and enhance the wilderness qualities, scenic beauties and ecological regimes of rivers and streams. Any construction within 100 feet of a scenic stream requires a scenic streams permit. The TSP would not impact the Blind River, the only scenic river within the project area.

6.17 Executive Order 11514, Protection and Enhancement of Environmental Quality

EO 11514 directs Federal agencies to "initiate measures needed to direct their policies, plans and programs so as to meet national environmental goals." The TSP complies with EO 11514.

6.18 Executive Order 11988, Floodplain Management

EO 11988 directs agencies to avoid development in floodplains to the maximum extent feasible. The TSP would reduce risk to the existing structures within the floodplain. The CEMVN is providing storm surge information to inform the St. Charles, St. James and St. John the Baptist Parishes Floodplain Administrators in their floodplain management implementation.

6.19 Executive Order 11990, Protection of Wetlands

Executive Order 11990 directs Federal agencies to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands, and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative. Mitigation planning was integrated into the planning by considering, individually and collectively, each of the NEPA mitigation actions of avoiding, minimizing, reducing and rectifying potential adverse impacts to wetlands to the extent practicable. Implementing the TSP requires compensatory mitigation for unavoidable impacts that will require replacing or providing substitute resources. A mitigation plan will be completed during feasibility level design and will be included in the final report. Unavoidable project-induced impacts will be mitigated in-kind, and hence, the proposed action complies with the EO 11990.

6.20 Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

EO 12898 requires agencies to make achieving environmental justice (EJ) part of their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of programs, policies and activities on minority populations and low-income populations. Potential EJ issues have been considered throughout planning. As part of the NEPA process, public and scoping meetings were held and attention was given to EJ issues. A public meeting specific to EJ issues was held on May 21, 2013 at the Knights of Columbus Hall in Lutcher, Louisiana. During these meetings, information was made available to the public to help assist in the identification of potential EJ issues. The CEMVN has concluded that there would be no potential EJ issues from implementing the TSP. The CEMVN encourages any interested parties to inform the agency of potential EJ concerns.

6.21 Executive Order 13112, Invasive Species

EO 13112 directs Federal agencies to prevent the introduction of invasive species; provide for their control; and minimize the economic, ecological and human health impacts that invasive species cause. The TSP is consistent with EO 13112 to the extent practicable and permitted by law and subject to the availability of appropriations, and within Administration budgetary limits. Relevant programs and authorities to prevent the introduction of invasive species would be used during construction. The CEMVN will not authorize, fund, or carry out actions likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless the CEMVN has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm would be taken in conjunction with the actions.

6.22 Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds

EO 13186 directs Federal agencies to take actions to further implement the Migratory Bird Treaty Act. The TSP has been evaluated for potential effects on migratory birds, with emphasis on species of concern. Many important habitats in the project area provide migratory bird shelter, nesting, feeding and roosting habitat. The TSP would potentially convert 719 acres of forested wetland/swamp habitat and 55 acres of dry and/or wet BLH habitat to levee. The TSP would enclose and potentially change hydrologic conditions of up to 8,424 acres of forested wetlands/swamp and BLH habitats. Implementation of the TSP will require compensatory mitigation for unavoidable project-induced impacts to bird and wildlife habitat.

7.0 PUBLIC INVOLVEMENT (*NEPA REQUIRED)

Public involvement is an important part of planning and decision-making. Agencies, non-governmental organizations, and citizens provided valuable input for TSP.

7.1 Public Meetings and Other Coordination Efforts

Public meetings in the three parish area were held during the study. These meetings included:

- June 6, 2013 - Project update to the CPRAB, Federal Emergency Management Agency (FEMA), Louisiana Department of Transportation and Development (LDOTD), Federal Highway Administration (FHWA), and other government agencies
- May 21, 2013 - Environmental justice community meeting in St. James Parish
- May 6, 2013 - Project update to CPRAB, FEMA, LDOTD, FHWA, and other agencies
- April 30, 2012 – Project update in St. John the Baptist Parish
- March 19, 2013 - Update to CPRAB, FEMA, LDOTD, FHWA, and other agencies
- February 22, 2013 - Update to CPRAB, FEMA, LDOTD, FHWA, and other agencies
- January 31, 2013 - Update to CPRAB, FEMA, LDOTD, FHWA, and other agencies
- November 15, 2012 - Project update in St. John the Baptist Parish
- February 16, 2011 - Project update to the St. John's Riverlands Civic Association
- January 21, 2009 - Public scoping meeting in St. John the Baptist Parish

Meeting participants were generally most interested in potential levee alignments and impacts to their communities. Other comments focused on the construction schedule, potential impacts to wetlands, the value of hurricane evacuation routes, and funding.

7.2 Draft Report Recipients

This report was distributed to Federal, state, and local agencies; businesses, libraries, and universities; and others. These stakeholders received a copy of the report (Table 7-1).

Table 7-1: List of report recipients.

Louisiana Congressional Delegation	Louisiana State Senators &	Levee Districts & Floodplain
Senator Mary Landrieu	Jody Amedee, State Senator	Amite River Basin Commission
Senator David Vitter	Randal L. Gaines, State Representative	Lafourche Basin Levee District
Congressman Rodney Alexander	Gregory A. Miller, State Representative	Pontchartrain Levee District
Congressman Charles W. Boustany, Jr.	Ed Price, State Representative	
Congressman William Cassidy	Gary L. Smith, Jr., State Senator	
Congressman John Fleming	Tom Willmott, State Representative	
Congressman Cedric Richmond		
Congressman Steve Scalise		
St. Charles Parish Government	**St. James Parish Government**	**St. John the Baptist Government**
V.J. St. Pierre, Jr., Parish President	Timothy P. "Timmy" Roussel	Natalie Robottom, Parish President
Parish Council	District Conservationist	
Permit Officer	Director of Operations	
	Parish Police Jury	
Town of Gramercy Government	**Town of Lutcher Government**	**Town of Vacherie Government**
Mayor	Clerk	Town Council
Aldermen	Aldermen	
Permit Official		
	Federal Agencies	
Advisory Council on Historic Preservation	**Department of Energy:** Office of Environmental Compliance	**Department of Transportation:** Division Administrator, Federal Highway Administration; Southwest Region, Federal Aviation
Department of Agriculture: Carl J. Breville. *Natural Resources Conservation Service:* Kevin Norton, State Conservationist; Michael Trusclair, District Conservationist	**Department of Homeland Security:** *Federal Emergency Management Agency:* Gary Zimmerer, Region VI	**Environmental Protection Agency:** Office of Federal Activities, EIS Filing Section: Region VI, Marine and Wetlands Section; Rhonda Smith, Region VI - Office of Planning and

Department of the Army: Rayford E. Wilbanks, MVD	**Department of the Interior:** *Office of Environmental Policy and Compliance. U.S. Fish and Wildlife Service:* Lacombe Office ; Lafayette Field Office, Jeff Weller, Field Supervisor	**Department of Commerce:** *National Oceanic and Atmospheric Administration:* David Bernhart, Protected Species Division; Richard Hartman, Habitat Conservation Division; NEPA Coordinator, Office of Program, Planning & Integration
State Agencies and Offices		
Honorable Bobby Jindal	**Louisiana Department of Agriculture & Forestry:** Office of Forestry; Mike Strain; Matthew Keppinger, Office of Agriculture & Environmental Science	**Louisiana Department of Public Works**
Lieutenant Governor Jay Dardenne	**Louisiana Department of Environmental Quality:** Environmental Planning Division ; Office of the Secretary; Scott Guilliams	**Louisiana Department of Transportation & Development**
Louisiana Secretary of State	**Louisiana Department of Health & Hospitals:** Office of Public Health, Center for Environmental Health	**Louisiana Department of Wildlife and Fisheries:** Secretary; Maurice B. Watson; Tim Morrison; Gary Lester, Natural Heritage Program
Attorney General's Office	**Louisiana Department of Natural Resources:** Keith Lovell, Interagency Affairs; Charlie Mestayer, Lafayette Field Office; Division of State Lands; Office of Conservation, Surface Mining Division; Consistency Coordinator, Coastal Resources Program	**Louisiana Division of Administration:** State Land Office; State Planning Office
Governor's Office for Coastal Activities	**Coastal Protection and Restoration Authority Board:** Garret Graves	**Louisiana Office of Cultural Development:** Pam Breaux, State Historic Preservation Officer; Division of Outdoor Recreation
Coastal Protection and Restoration Authority: Stephanie Zumo		**Louisiana State Board of Commerce & Industry**
	Native American Tribes	
Adai Caddo Indians of Louisiana	Clifton Choctaw Tribe of Louisiana	Point au Chien Tribe
Alabama Coushatta Tribe of Texas	Coushatta Tribe of Louisiana	Quapaw Tribe of Oklahoma
Biloxi Chitimacha Confederation/Bayou	Four-Winds Cherokee Tribe	Seminole Tribe of Florida
Caddo Nation	Grand Caillou/Dulac Band	Seminole Nation of Oklahoma
Chitimacha Tribe of Louisiana	Isle de Jean Charles Band	Tunica-Biloxi Tribe of Louisiana
Choctaw-Apache Tribe of Ebarb	Jena Band of Choctaw Indians	United Houma Nation
Choctaw Nation of Oklahoma	Louisiana Choctaw Tribe	
Media Outlets	**Businesses & Individuals**	**Libraries & Universities**
St Charles Herald Guide	Entergy	St. John The Baptist Parish Library
L'Observateur	Wally Landry, Crucial, Inc.	St. James Parish Library
News Examiner	Donald Landry, South Louisiana Environmental Council	**Louisiana State University:** Craig A. Johnson, Louisiana Geographic Information Center; Charles Wilson,

7.3 Views of the Public

This report is available for public review and comment for 45 days. The final report will include comments received. Comments received at public meetings will be included.

8.0 RECOMMENDATIONS

Information found in this document and further developed during feasibility analysis, as well as input from agencies and comments from the public, will help refine the potential solutions to reduce hurricane and storm surge flood damages to St. Charles, St. John the Baptist and St. James Parishes, Louisiana. These sources of information will assist the USACE Commander in making an informed decision, which will be documented in the final report.

8.1 Recommended Plan

The TSP is Alternative C, which is also the NED plan, which maximizes net benefits consistent with protecting the Nation's environment. Alternative C begins at the west guide levee of the Bonnet Carré Spillway and extends to Hope Canal. The levee then tracks south to a location near the Mississippi River Levee. It is approximately 18.27 miles long and includes 4 pump stations along the alignment. Borrow material would come from the Bonnet Carré Spillway or alternative borrow sources not yet identified. It would also require environmental control structures (culverts with flap gates) along the length of the alignment that would be operated during hurricane and tropical storm surge events. See Appendix B for detailed engineering information.

8.2 Plan Implementation

The following sections describe the NFS financing and the division of plan responsibilities.

Federal and Non-Federal Cost-Sharing

The State of Louisiana acting through the PLD, is the NFS for the feasibility phase of the project. The cost-share during the feasibility phase is 50 percent Federal and 50 percent non-Federal. Following the feasibility phase, CPRAB will be the non-Federal sponsor for planning, design, construction, operation, maintenance, repair, replacement and rehabilitation. The cost share for the planning, design and construction of the project will be 65 percent Federal and 35 percent non-Federal. Among other responsibilities, the CPRAB must provide all project LERRDs required for the project and submit any work-in-kind request to the Federal government for the pre-construction engineering, and design (PED) of the project. The OMRR&R cost of the project is estimated to be approximately $4,128,075 and is a 100 percent CPRAB responsibility. The project construction cost is estimated to be approximately $880,851,070. These costs are subject to revision as a result of feasibility level design and will be documented in the final report.

8.2.1 Federal Responsibilities

The Federal government will be responsible for PED and construction of the project in accordance with the applicable provisions of Public Law 99-662 (WRDA of 1986). The Government, subject to Congressional authorization and the availability of funds and using those funds provided by the NFS, shall expeditiously construct the project, applying those procedures usually applied to Federal projects, pursuant to Federal laws, regulations, and policies.

8.2.2 Non-Federal Responsibilities

Federal implementation of the project would be subject to the NFS agreeing to comply with applicable Federal laws and policies, including but not limited to the following:

a) Provide 35 percent of total project costs as further specified below:

1. Provide the required non-Federal share of design costs in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

2. Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs;

3. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the project;

4. Provide, during construction, any additional funds necessary to make its total contribution equal to 35 percent of total project costs;

b) Shall not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefore, to meet any of the non-Federal obligations for the project unless the Federal agency providing the Federal portion of such funds verifies in writing that expenditure of such funds for such purpose is authorized;

c) Not less than once each year, inform affected interests of the extent of protection afforded by the project;

d) Agree to participate in and comply with applicable Federal floodplain management and flood insurance programs;

e) Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires a non-Federal interest to prepare a floodplain management plan within one year after the date of signing a project partnership agreement, and to implement such plan not later than one year after completion of construction of the project;

f) Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

g) Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the level of protection the project affords, hinder operation and maintenance of the project, or interfere with the project's proper function;

h) Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601- 4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

i) For so long as the project remains authorized, OMRR&R the project or functional portions of the project, including any mitigation features, at no cost to the Federal government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal government;

j) Give the Federal government a right to enter, at reasonable times and in a reasonable manner, upon property that the NFS owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

k) Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;

l) Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 CFR Section 33.20;

m) Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c et seq.);

n) Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the CERCLA, Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal government determines to be required for construction, operation, and maintenance of the project. However, for lands that the Federal government determines to be subject to the navigation servitude, only the Federal government shall perform such investigations unless the Federal government provides the NFS with prior specific written direction, in which case the NFS shall perform such investigations in accordance with such written direction;

o) Assume, as between the Federal government and the NFS, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal government determines to be required for construction, operation, and maintenance of the project;

p) Agree, as between the Federal government and the NFS, that the NFS shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA; and

q) Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103(j) of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213(j)), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project or separable element.

r) Shall not use any project features or lands, easements, and rights-of-way required for such features as a wetlands bank or mitigation credit for any other project;

s) Pay all costs due to any project betterments or any additional work requested by the sponsor, subject to the sponsor’s identification and request that the Government accomplish such betterments or additional work, and acknowledgement that if the Government in its sole discretion elects to accomplish the requested betterments or additional work, or any portion thereof, the Government shall so notify the NFS in writing that sets forth any applicable terms and conditions.

9.0 LIST OF PREPARERS (*NEPA Required)

Name	Office	Discipline/Role
Tim Axtman	RPEDS Plan Formulation Branch	Senior Plan Formulator
Christopher Brown	RPEDS Environmental Compliance Branch	HTRW
Troy Constance	Chief, RPEDS	District Quality Control
Travis Creel	RPEDS, Plan Formulation Branch	Lead Plan Formulator
Rob Dauenhauer	Engineering Division, Structures Branch	Structures Design
Nathan Dayan	RPEDS Environmental Planning Branch	Fisheries Resources, Essential Fish Habitat
Pamela DeLoach	Engineering Division, Engineering Control Branch	District Quality Control
Joan Exnicios	Chief, RPEDS Environmental Planning Branch	District Quality Control
Douglas Ferrell	Engineering Division, Design Services Branch	Relocations
Tammy Gilmore	RPEDS Environmental Planning Branch	Wildlife Resources, Endangered Species
Eric Glisch	Engineering Division, Hydraulics and Hydrologic Branch	Water Quality
Richel Green	Engineering Division, Design Services Branch	Relocations
Judith Gutierrez	Real Estate Division	District Quality Control
Rebecca Hill	RPEDS Environmental Planning Branch	Tribal Liaison Coordination
Paul Hughbanks	RPEDS Environmental Planning Branch	Archaeology
William P. Klein Jr.	RPEDS Environmental Planning Branch	Environmental Manager, Environmental Resources Planning, Mitigation, Adaptive Management and Monitoring, Habitat Impacts
Fay Lachney	RPEDS Plan Formulation Branch	Senior Plan Formulator
Patricia Leroux	RPEDS Environmental Planning Branch	Appendices, Vegetation Resources
J. Ben Logan	RPEDS Economics Branch	Socioeconomic Resources
Keven Lovetro	RPEDS Economics Branch	Socioeconomic Resources
Brian Maestri	RPEDS Economics Branch	Socioeconomic Resources
Greg Miller	Chief, RPEDS Plan Formulation Branch	District Quality Control
Kelly McCaffrey	RPEDS Environmental Planning Branch	Aesthetic Resources
An Nguyen	Engineering Division, Civil Branch	Levee Design
Darrell Normand	Engineering Division, Design Services Branch	Cost Engineering
Paul Oakland	Engineering Division, Design Services Branch	Relocations
Hasan Pourtaheri	Engineering Division, Hydraulics and Hydrologic Branch	ADCIRC & Surge Modeling
Miguel Ramos	Engineering Division, Design Services Branch	Cost Engineering
Courtney Reed	RPEDS Economics Branch	Socioeconomic Resources
Jerica Richardson	RPEDS, Plan Formulation Branch	Lead Plan Formulator
Sandra Stiles	RPEDS Environmental Planning Branch	District Quality Control
Christopher Talbert	Engineering Division, Design Services Branch	Relocations
Danielle Tommaso	RPEDS, Plan Formulation Branch	Plan Formulator
Ron Taylor	Engineering Division, Hydraulics and Hydrologic Branch	Interior Drainage
Walter Teckemeyer	Engineering Division, Engineering Control Branch	Project Engineer
Jeff Varisco	Programs & Project Management Division	Project Manager
Jennifer Wedge	Engineering Division, Structures Branch	Structures Design
Debra Wright	RPEDS Environmental Planning Branch	Recreational Resources

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A
ENVIRONMENTAL APPENDIX

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A
Annex A

Clean Water Act Section 401 Water Quality Certification
Clean Water Act Section 404(b)(1) Evaluation

*****Note: these documents, associated analyses and coordination will be completed during the feasibility-level analysis phase of this study which would occur following release of the Draft Environmental Impact Statement, and would be included in the Final Environmental Impact Statement.

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A
Annex B

Louisiana Coastal Resources Program Consistency Determination

*****Note: this document, associated analyses and coordination will be completed during the feasibility-level analysis phase of this study which would occur following release of the Draft Environmental Impact Statement, and would be included in the Final Environmental Impact Statement.

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A
Annex C

Louisiana State Department of Wildlife and Fisheries Mitigation Letter

BOBBY JINDAL
GOVERNOR

State of Louisiana

DEPARTMENT OF WILDLIFE AND FISHERIES
OFFICE OF WILDLIFE

ROBERT J. BARHAM
SECRETARY

JIMMY L. ANTHONY
ASSISTANT SECRETARY

October 24, 2012

Colonel Edward R. Fleming
District Commander
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

RE: *West Shore Lake Pontchartrain Hurricane Levee Project*

Dear Colonel Fleming:

The professional staff of the Louisiana Department of Wildlife and Fisheries (LDWF) has reviewed limited information concerning the West Shore, Lake Pontchartrain, Louisiana, Hurricane and Storm Damage Risk Reduction Feasibility Study in Ascension, St. Charles, St. James, and St. John the Baptist Parishes, Louisiana. The information included three preliminary levee alignments which would provide Federal hurricane protection to the western shore of Lake Pontchartrain. Based upon our review of the limited information, LDWF provides the following comments and questions. We recommend that each comment and question be thoroughly considered and satisfactorily addressed by the U.S. Army Corps of Engineers (USACE).

Natural and Scenic River

The Blind River, which is a Louisiana designated Natural and Scenic River, is located within Alignment D of the proposed project. The purpose of the Natural and Scenic Rivers Act is to preserve, protect, develop, reclaim, and enhance the wilderness qualities, scenic beauties, and ecological regime of certain free-flowing streams. A Scenic Rivers Permit will be required for Alignment D if LDWF determines that the levee has the potential to directly and significantly degrade the ecological integrity of the river. Please contact Mr. Keith Cascio at 318-343-4045 or kcascio@wlf.la.gov concerning this Natural and Scenic River.

Wildlife Management Area

Our database indicates that all levee Alignments (i.e., A, C and D) occur within the boundaries of Maurepas Swamp Wildlife Management Area (WMA). However, Alignment D will impact the WMA more significantly than the other alignments. No activities shall occur within any WMA/refuge without first obtaining proper authorization from LDWF. Please contact Mr. Mike Windham at 504-284-5268 or cwindham@wlf.la.gov for more information about appropriate WMA authorizations.

Endangered Species

Manatees (*Trichechus manatus*) are known to occur in the surrounding water bodies of Alignment D. Manatees are large mammals inhabiting both fresh and salt water. Although most manatees are year round residents of Florida or Central America, they have been known to migrate to areas along the

Atlantic and Gulf Coast during the summer months. Manatees are an endangered species protected under the Endangered Species Act of 1973 and the Federal Marine Mammal Protection Act of 1972. In Louisiana, taking or harassment of the manatee is a violation of state and federal laws. Critical habitat for manatees includes marine submergent vascular vegetation (sea-grass beds). Areas with sea-grass beds should be avoided during project activities if possible. Please contact Mr. Beau Gregory at 337-491-2575 or bgregory@wlf.la.gov for more information about manatees.

Bird Nesting Colonies

Our Natural Heritage Program database indicates the presence of bird nesting colonies within one mile of the western end of Alignment D. Please be aware that entry into or disturbance of active breeding colonies is prohibited by LDWF. To minimize disturbance to colonial nesting birds, LDWF prohibits work within a certain radius of an active nesting colony. The following restrictions on activity should be observed:

- For colonies containing nesting wading birds (i.e., herons, egrets, night-herons, ibis, roseate spoonbills, anhingas, and/or cormorants), all project activity occurring within 300 meters of an active nesting colony should be restricted to the non-nesting period (i.e., September 1 through February 15).
- For colonies containing nesting gulls, terns, and/or black skimmers, all project activity occurring within 400 meters (700 meters for brown pelicans) of an active nesting colony should be restricted to the non-nesting period (i.e., September 16 through April 1).

Please contact Ms. Carolyn Michon at 225-765-2357 or cmichon@wlf.la.gov for more information on bird nesting colonies.

Compensatory Mitigation

This levee project may result in the loss of significant habitat that provides ecological services such as resource production, water quality improvement, flood peak reduction and hurricane abatement. The loss of these ecological services must be compensated with mitigation. Therefore, if the proposed activity is approved by the regulatory agencies, the applicant shall develop a mitigation plan designed to off-set all impacts to wetland functions and fish and wildlife resources. A mitigation plan should be approved by the resource and regulatory agencies and be implemented concurrently with levee construction. Furthermore, the mitigation shall be located within the same hydrologic basin as the impacts.

Planning Considerations

LDWF believes that alternative borrow sites should be considered, including but not limited to, hauled in material to avoid further impacts. Hauled in material shall be free of contaminates. Borrow sites from within the project area would impact a larger footprint of wildlife and fisheries habitat.

The proposed levee alignments, in particular Alignment D, could potentially restrict recreational opportunities, boating access and other fishing vessels.

Summary and Conclusions

LDWF understands the need to protect these communities; nevertheless, we believe a proper plan would ensure that impacts are minimized and all necessary mitigation is carried out. LDWF believes Alignment A will result in the least amount of impact to valuable forested wetland habitat. Understandably, Alignment C might be more feasible from an engineering standpoint. Alignment D will likely result in the most impacts to fish and wildlife resources, including Maurepas Swamp WMA and Blind River.

Proposed Alignments C and D will impound wetlands thereby reducing exchange of nutrients which most estuarine species are dependent upon. LDWF believes that precautions should be taken to allow for adequate aquatic species migration. Should Alignments C or D be chosen, adequately sized water control structures must be placed within the levee to allow for ingress and egress of estuarine species, proper drainage, tidal exchange, and the natural release of fresh water (sheet flow) into the coastal system. Water control structures, including but not limited to, culverts should be scaled as large as possible, located frequently, and should be placed in a way that mimics natural bottom contours.

LDWF is further concerned with indirect impacts which may result from the proposed activity. Specifically, by affording flood protection to an area comprised of wetlands, the project may promote future development in wetland areas. Additionally, the levee alignment may alter natural periods of inundation or soil saturation in the impounded wetlands and could prove detrimental to their function and longevity. Alignments C and D could likely reduce the natural storage capacity the wetlands provide, thereby, increasing the risk of induced flooding in other areas.

The Louisiana Department of Wildlife and Fisheries submits these recommendations to the U.S. Army Corps of Engineers in accordance with provisions of the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.). Please do not hesitate to contact Mr. Kyle Balkum at 225-765-2819 should you need further assistance.

Sincerely,

Jimmy L. Anthony
Assistant Secretary

c: LDNR, Office of Coastal Management
EPA, Marine & Wetlands Section
National Marine Fisheries Service
USFWS, Ecological Services
Keith Cascio, LDWF
Beau Gregory, LDWF
Barry Hebert, LDWF
Carolyn Michon, LDWF
Mike Windham, LDWF
Christian Winslow, LDWF

-----Original Message-----
From: Balkum, Kyle [mailto:kbalkum@wlf.la.gov]
Sent: Thursday, May 23, 2013 3:29 PM
To: Klein, William P Jr MVN
Cc: Winslow, Christian J.; Cascio, Keith; Hebert, Barry; Ribbeck, Kenny; Breaux, Catherine M MVN; 'Catherine_Breaux@fws.gov'; 'Lisa Abernathy'; 'Ettinger.John@epamail.epa.gov'; Richardson, Jerica M MVN; Varisco, Jeffrey J MVN; Myers, Randy; Tuma, Tommy; Mooney, Brad
Subject: LDWF Scoping Comments (Part 2) - West Shore Lake Pontchartrain

Bill,

In addition to our previously submitted scoping comments, LDWF is providing the West Shore-LP PDT with proposed mitigation measures that we believe can best offset impacts associate with levee construction. You will receive the following two documents today:

1. pdf-document that briefly describes the nine conceptual mitigation measures proposed by LDWF, and
2. jpg-map that illustrates the nine mitigation measures (to follow in a subsequent e-mail).

We hope that this draft mitigation plan is included in the Draft TSP.

We look forward to working with you to further develop these proposed mitigation measures in order to ensure that project impacts are adequately and appropriately mitigated for.

Thanks,
Kyle

Kyle F. Balkum
Biologist Program Manager, Habitat Section -
Louisiana Department of Wildlife and Fisheries
2000 Quail Dr., Baton Rouge, LA 70808
225-765-2819 / kbalkum@wlf.la.gov

DRAFT Maurepas Swamp WMA Mitigation Proposals

Prepared by the Louisiana Department of Wildlife and Fisheries (LDWF)

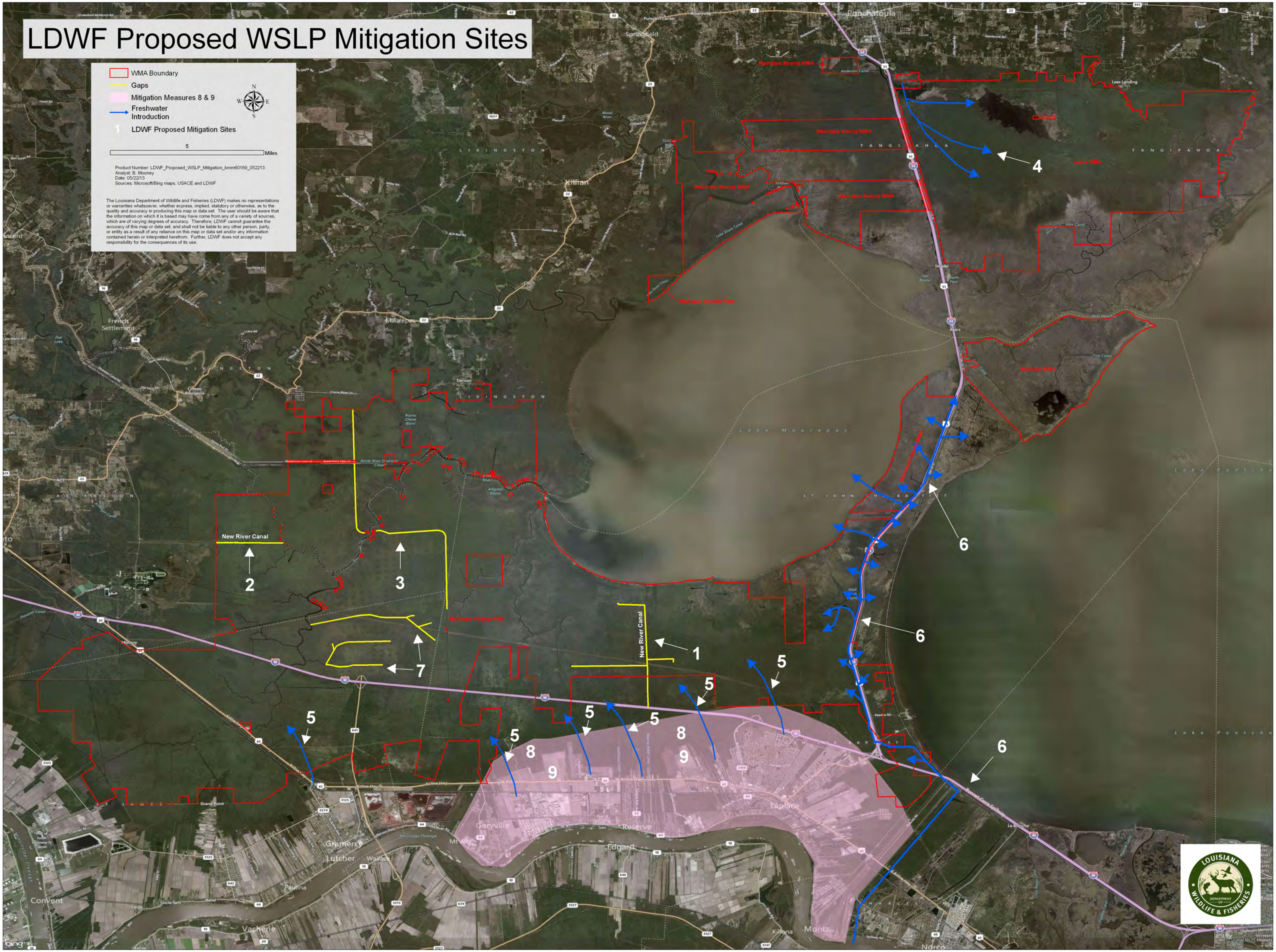
Presented to the West Shore-Lake Pontchartrain Project Delivery Team (PDT)

May 23, 2013

The elimination of nutrient and freshwater inputs threatens the sustainability of the Maurepas Swamp. The most effective strategy to restore health and productivity of the swamp is construction of Mississippi River reintroductions into Maurepas Swamp. However, additional measures such as eliminating barriers to surface flow patterns are also needed, not only to compliment the planned river reintroductions, but also to improve current hydrologic conditions. Therefore, the mitigation measures identified below by LDWF primarily aim to enhance or improve surface hydrology until such time that river reintroductions are constructed. The mitigation measures are still conceptual and will require further planning and engineering. LDWF also prioritized each measure (i.e., High, Medium or Low) to inform the PDT on which measures are believed to be most beneficial.

1. Gap spoil banks along Reserve Relief Canal (**High priority**).
2. Gap spoil banks along New River Canal (**High priority**).
3. Gap/degrade railroad bed which traverses the swamp beginning from Hope Canal and proceeding north and west to the northern property boundary (crossing Blind River and Amite River Diversion Canal (**High priority**).
4. Improve through flow of Hammond wastewater into existing Joyce WMA outfall area (**High priority**).
5. Make efficient use of stormwater and wastewater produced by communities south of I-10 (e.g., Laplace, Ascension Parish) by distributing this water into the Maurepas Swamp (**High priority**).
6. Diversion of freshwater from Bonnet Carre Spillway guide levee to the swamps and marshes to the northwest (**Medium priority**).
7. Gap any spoil banks north of I-10 in the area of Tennessee Williams (**Medium priority**).
8. Preserve existing wetlands by acquiring land in fee title that is enclosed within the levee (**Low priority**).
9. Restrict development in wetlands enclosed within the levee (**Low priority**).

The number of the proposed mitigation measure corresponds with the number on the accompanying map.



LDWF Proposed WSLP Mitigation Sites
WMA Boundary
Gaps
Mitigation Measures 8 & 9
Freshwater Introduction
LDWF Proposed Mitigation Sites
N
W
E
S
5
Miles
Product Number: LDWF_Proposed_WSLP_Mitigation_bmm60169_052213
Analyst: B. Mooney
Date: 05/22/13
Sources: Microsoft/Bing maps, USACE and LDWF
The Louisiana Department of Wildlife and Fisheries (LDWF) makes no representations or warranties whatsoever, whether express, implied, statutory or otherwise, as to the quality and accuracy in producing this map or data set. The user should be aware that the information on which it is based may have come from any of a variety of sources, which are of varying degrees of accuracy. Therefore, LDWF cannot guarantee the accuracy of this map or data set, and shall not be liable to any other person, party, or entity as a result of any reliance on this map or data set and/or any information contained herein or interpreted herefrom. Further, LDWF does not accept any responsibility for the consequences of its use.
Ponchatoula
Springfield
Killian
Maurepas
French Settlement
L I V I N G S T O N
T A N G I P A H O A
A S C E N S I O N
S T J O H N T H E B A P T I S T
Lake Maurepas
Lake Pontchartrain
New River Canal
1
2
3
4
5
6
7
8
9
Garyville
Reserve
Laplace
Gramercy
Lutcher
Edgard
Convent
Vacherie
Paulina
Montz
Killona
Norco
LOUISIANA DEPARTMENT OF WILDLIFE & FISHERIES

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A
Annex D

National Marine Fisheries Service Scoping / Planning Aid Letter

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701

January 29, 2009 F/SER46/RH:jk
225/389-0508

Ms. Elizabeth Wiggins, Chief
Environmental Compliance and Analysis Branch
New Orleans District
Department of the Army, Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Ms. Wiggins:

NOAA's National Marine Fisheries Service (NMFS) has received the public notice dated December 17, 2008, announcing a scoping meeting and the intention of the New Orleans District (NOD) to prepare an Environmental Impact Statement (EIS) for the **West Shore-Lake Pontchartrain, Louisiana; Hurricane and Storm Damage Risk Reduction Feasibility Study**. The purpose of the study is to assess the feasibility and impacts of providing hurricane and storm surge damage risk reduction measures to a study area bounded by the Bonnet Carre Spillway to the east, the Mississippi River to the south, Lakes Pontchartrain and Maurepas to the north, and the St. James Parish/Ascension Parish line to the west. According to the public notice, previous studies have identified four preliminary levee alignments. The draft EIS will consider those alignments and other reasonable alternatives to provide hurricane and storm risk reduction to the project area.

Aquatic and tidally influenced wetland habitats in portions of the study area are designated as essential fish habitat (EFH) for economically important fishery species managed by the Gulf of Mexico Fishery Management Council (GMFMC), including white shrimp and red drum. Primary categories of EFH in the study area include estuarine emergent wetlands, submerged aquatic vegetation, mud substrates, and estuarine water column. Detailed information on federally-managed fisheries and their EFH is provided in the 2005 generic amendment of the Fishery Management Plans for the Gulf of Mexico prepared by the GMFMC. The generic amendment was prepared as required by the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act, P.L. 104-297).

In addition to being designated as EFH for white shrimp and red drum, water bodies and wetlands in the study area provide nursery and foraging habitats supportive of a variety of economically important marine fishery species, such as striped mullet, Atlantic croaker, gulf menhaden, and blue crab. Some of these species also serve as prey for other fish species managed under the Magnuson-Stevens Act by the GMFMC (e.g., mackerels, snappers, and groupers) and highly migratory species managed by NMFS (e.g., billfishes and sharks).

NMFS recommends the EIS include separate sections titled "Essential Fish Habitat" and "Marine Fishery Resources" that identify the EFH and fisheries resources of the study area. The EIS should describe the potential direct and indirect impacts on fishery resources and each category of EFH used by federally managed fishery species and their life stages. A discussion should be included on direct adverse impacts that may result from placement of fill in wetlands to construct levee sections and the dredging of channels in shallow water areas to allow access of construction equipment. The EIS should evaluate alternatives to any activity that would result in an adverse impact to these resources and determine if there are lesser environmentally damaging methods. These sections also should evaluate whether mitigative actions would adequately offset net impacts to EFH and associated fishery resources.

The EIS developed for this project should include a section titled "Mitigation" that contains sufficient information to support a determination of compliance with the Clean Water Act Section 404(b)(1) guidelines and Section 2036 of the Water Resources Development Act of 2007. This includes the joint Environmental Protection Agency/Department of the Army final rule on compensatory mitigation for losses of aquatic resources, issued April 10, 2008, which amends the Clean Water Act guidelines. Perhaps most pertinent therein is the requirement that measures should be taken first to avoid, then minimize, and mitigate and that mitigation plans should include 12 components: 1) objectives; 2) site selection (rationale); 3) site protection instrument; 4) baseline information; 5) determination of credits; 6) mitigation work plan; 7) maintenance plan; 8) performance standards; 9) monitoring requirements; 10) long-term management plan; 11) adaptive management plan; and,12) financial assurances.

We appreciate the opportunity to provide input into the issues that should be evaluated in the EIS for this project. If you have any questions regarding our comments, please contact Mr. Richard Hartman of our Habitat Conservation Division, Baton Rouge office at (225) 389-0508, ext 203.

Sincerely,

Miles M. Croom
Assistant Regional Administrator
Habitat Conservation Division

c:
FWS, Lafayette
EPA, Dallas
LA DNR, Consistency
F/SER46, Swafford
F/SER4, Dale
Files

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A
Annex E

Natural Resources Conservation Service Prime and Unique Farmlands Coordination

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
3737 Government Street
Alexandria, LA 71302

(318) 473-7751
Fax: (318) 473-7626

June 8, 2013

Eric Williams
US Army Corp of Engineers
Eric.M.Williams@usace.army.mil

RE: St. John and St. Charles Parishes, LA – West Shore Lake Pontchartrain Levee

Dear Mr. Williams:

I have reviewed the above referenced project for potential requirements of the Farmland Protection Policy Act (FPPA) and potential impact to Natural Resource Conservation Service projects in the immediate vicinity.

Projects are subject to FPPA requirements if they may irreversibly convert farmland (directly or indirectly) to nonagricultural use and are completed by a federal agency or with assistance from a federal agency. For the purpose of FPPA, farmland includes prime farmland, unique farmland, and land of statewide or local importance. Farmland subject to FPPA requirements can be forest land, pastureland, cropland, or other land, but not water or urban built-up land.

The project map and narrative submitted with your request indicates that the proposed construction areas will potentially impact the following prime or unique farmland soils:

CmA – Cancienne silt loam, 0 to 1 percent slopes	12.8 ac.	
GrA – Gramercy silty clay, 0 to 1 percent slopes	31.0 ac.	
SkA – Schriever clay, 0 to 1 percent slopes	11.6 ac	
Total acres prime farmland	55.4 ac.	RV = 88

Please find attached an NRCS-CPA-106 Farmland Conversion Impact Rating for Corridor Type Projects with our agencies information completed. Furthermore, we do not predict impacts to NRCS work in the vicinity.

For specific information about the soils found in the project area, please visit our Web Soil Survey at the following location: http://websoilsurvey.nrcs.usda.gov/

For more information on FPPA requirements or the process to receive a Farmland Conversion Impact Rating (Form AD-1006 or CPA-106) please visit the following location:
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/fppa/

Please direct all future correspondence to me at the address shown above.

Respectfully,

Sarah Haymaker

Sarah Haymaker
State Conservationist

Attachment

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service

NRCS-CPA-106
(Rev. 1-91)

FARMLAND CONVERSION IMPACT RATING FOR CORRIDOR TYPE PROJECTS

PART I *(To be completed by Federal Agency)*		3. Date of Land Evaluation Request 6/7/13	4. Sheet 1 of
1. Name of Project **West Shore Lake Pontchartrain**		5. Federal Agency Involved **US Army Corp of Engineers**	
2. Type of Project **Levee**		6. County and State **St. John and St. Charles Parishes, LA**	
PART II *(To be completed by NRCS)*		1. Date Request Received by NRCS **6/7/13**	2. Person Completing Form **M. Lindsey**
3. Does the corridor contain prime, unique statewide or local important farmland? (If no, the FPPA does not apply - Do not complete additional parts of this form). YES ☑ NO ☐			4. Acres Irrigated -- / Average Farm Size 676
5. Major Crop(s) **Soybeans**	6. Farmable Land in Government Jurisdiction Acres: 45143 % 33		7. Amount of Farmland As Defined in FPPA Acres: 33,193 % 24
8. Name Of Land Evaluation System Used **LESA**	9. Name of Local Site Assessment System **NA**		10. Date Land Evaluation Returned by NRCS **6/8/13**

PART III *(To be completed by Federal Agency)*	Maximum Points	Alternative Corridor For Segment ______ Corridor A	Corridor B	Corridor C	Corridor D
A. Total Acres To Be Converted Directly		245			
B. Total Acres To Be Converted Indirectly, Or To Receive Services					
C. Total Acres In Corridor		245			
PART IV *(To be completed by NRCS)* **Land Evaluation Information**					
A. Total Acres Prime And Unique Farmland		55.4			
B. Total Acres Statewide And Local Important Farmland		na			
C. Percentage Of Farmland in County Or Local Govt. Unit To Be Converted		0.16			
D. Percentage Of Farmland in Govt. Jurisdiction With Same Or Higher Relative Value		100			
PART V *(To be completed by NRCS)* **Land Evaluation Information Criterion Relative value of Farmland to Be Serviced or Converted (Scale of 0 - 100 Points)**		88			
PART VI *(To be completed by Federal Agency)* **Corridor Assessment Criteria (These criteria are explained in 7 CFR 658.5(c))**	**Maximum Points**				
1. Area in Nonurban Use	15				
2. Perimeter in Nonurban Use	10				
3. Percent Of Corridor Being Farmed	20				
4. Protection Provided By State And Local Government	20				
5. Size of Present Farm Unit Compared To Average	10				
6. Creation Of Nonfarmable Farmland	25				
7. Availablility Of Farm Support Services	5				
8. On-Farm Investments	20				
9. Effects Of Conversion On Farm Support Services	25				
10. Compatibility With Existing Agricultural Use	10				
TOTAL CORRIDOR ASSESSMENT POINTS	160	0	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland (From Part V)	100	88	0	0	0
Total Corridor Assessment (From Part VI above or a local site assessment)	160	0	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	88	0	0	0

1. Corridor Selected:	2. Total Acres of Farmlands to be Converted by Project:	3. Date Of Selection:	4. Was A Local Site Assessment Used? YES ☐ NO ☐

5. Reason For Selection:

Signature of Person Completing this Part: DATE

NOTE: Complete a form for each segment with more than one Alternate Corridor

CORRIDOR - TYPE SITE ASSESSMENT CRITERIA

The following criteria are to be used for projects that have a linear or corridor - type site configuration connecting two distant points, and crossing several different tracts of land. These include utility lines, highways, railroads, stream improvements, and flood control systems. Federal agencies are to assess the suitability of each corridor - type site or design alternative for protection as farmland along with the land evaluation information.

(1) How much land is in nonurban use within a radius of 1.0 mile from where the project is intended?
More than 90 percent - 15 points
90 to 20 percent - 14 to 1 point(s)
Less than 20 percent - 0 points

(2) How much of the perimeter of the site borders on land in nonurban use?
More than 90 percent - 10 points
90 to 20 percent - 9 to 1 point(s)
Less than 20 percent - 0 points

(3) How much of the site has been farmed (managed for a scheduled harvest or timber activity) more than five of the last 10 years?
More than 90 percent - 20 points
90 to 20 percent - 19 to 1 point(s)
Less than 20 percent - 0 points

(4) Is the site subject to state or unit of local government policies or programs to protect farmland or covered by private programs to protect farmland?
Site is protected - 20 points
Site is not protected - 0 points

(5) Is the farm unit(s) containing the site (before the project) as large as the average - size farming unit in the County ? (Average farm sizes in each county are available from the NRCS field offices in each state. Data are from the latest available Census of Agriculture, Acreage or Farm Units in Operation with $1,000 or more in sales.)
As large or larger - 10 points
Below average - deduct 1 point for each 5 percent below the average, down to 0 points if 50 percent or more below average - 9 to 0 points

(6) If the site is chosen for the project, how much of the remaining land on the farm will become non-farmable because of interference with land patterns?
Acreage equal to more than 25 percent of acres directly converted by the project - 25 points
Acreage equal to between 25 and 5 percent of the acres directly converted by the project - 1 to 24 point(s)
Acreage equal to less than 5 percent of the acres directly converted by the project - 0 points

(7) Does the site have available adequate supply of farm support services and markets, i.e., farm suppliers, equipment dealers, processing and storage facilities and farmer's markets?
All required services are available - 5 points
Some required services are available - 4 to 1 point(s)
No required services are available - 0 points

(8) Does the site have substantial and well-maintained on-farm investments such as barns, other storage building, fruit trees and vines, field terraces, drainage, irrigation, waterways, or other soil and water conservation measures?
High amount of on-farm investment - 20 points
Moderate amount of on-farm investment - 19 to 1 point(s)
No on-farm investment - 0 points

(9) Would the project at this site, by converting farmland to nonagricultural use, reduce the demand for farm support services so as to jeopardize the continued existence of these support services and thus, the viability of the farms remaining in the area?
Substantial reduction in demand for support services if the site is converted - 25 points
Some reduction in demand for support services if the site is converted - 1 to 24 point(s)
No significant reduction in demand for support services if the site is converted - 0 points

(10) Is the kind and intensity of the proposed use of the site sufficiently incompatible with agriculture that it is likely to contribute to the eventual conversion of surrounding farmland to nonagricultural use?
Proposed project is incompatible to existing agricultural use of surrounding farmland - 10 points
Proposed project is tolerable to existing agricultural use of surrounding farmland - 9 to 1 point(s)
Proposed project is fully compatible with existing agricultural use of surrounding farmland - 0 points

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A
Annex F

State Historic Preservation Officer (SHPO) and Tribal Coordination Letters

*****Note: coordination and documentation will be completed during the feasibility-level analysis phase of this study which would occur following release of the Draft Environmental Impact Statement, and would be included in the Final Environmental Impact Statement.

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A
Annex G

U.S. Fish and Wildlife Service Draft Coordination Act Report

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

June 5, 2013

Colonel Richard L. Hansen
District Commander
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Hansen:

Please reference the "West Shore, Lake Pontchartrain, Louisiana, Hurricane and Storm Damage Risk Reduction Feasibility Study." The study was authorized by resolutions adopted by the U.S. House Committee on Public Works on July 29, 1971, and the U.S. Senate Committee on Public Works September 20, 1974. The Fish and Wildlife Service (Service) has prepared five Planning-aid Reports dated January 21, 1985, June 30, 1987, April 3, 1997, May 4, 2001, and October 9, 2012, for previous reconnaissance studies and one letter for a Notice of Intent dated January 9, 2009.

This draft report contains a description of existing fish and wildlife resources in the project area, discusses future with-project (FWP) and future without-project (FWOP) habitat conditions, identifies fish and wildlife-related impacts, and provides recommendations to improve the proposed West Shore, Lake Pontchartrain project. This document does not constitute the report of the Secretary of the Interior as required by Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). The Service is coordinating with National Marine Fisheries (NMFS) and Louisiana Department of Wildlife and Fisheries (LDWF); their comments will be incorporated into the final report.

We appreciate the cooperation of your staff on this study. Should your staff have any questions regarding the enclosed report, please have them contact Ms. Catherine Breaux (504/862-2689) of this office.

Sincerely,

Jeffrey D. Weller
Supervisor
Louisiana Ecological Services Office

Enclosure

cc: Environmental Protection Agency, Dallas, TX
LA Dept. of Natural Resources (CMD), Baton Rouge, LA
Coastal Protection and Restoration Authority (CPRA), Baton Rouge, La
Natural Resources Conservation Service, Alexandria, LA

Draft Fish and Wildlife Coordination Act Report
for the
West Shore, Lake Pontchartrain, Louisiana, Hurricane and Storm Damage Risk Reduction Feasibility Study in Ascension, St. Charles, St. James, and St. John the Baptist Parishes, Louisiana

SUBMITTED TO
NEW ORLEANS DISTRICT
U.S. ARMY CORPS OF ENGINEERS
AND
PONTCHARTRAIN LEVEE DISTRICT

PREPARED BY
CATHERINE BREAUX
FISH AND WILDLIFE BIOLOGIST

U.S. FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
LAFAYETTE, LOUISIANA
JUNE 2013
U.S. FISH AND WILDLIFE SERVICE – SOUTHEAST REGION

TABLE OF CONTENTS

FIGURES AND TABLES

INTRODUCTION

The U.S. Army Corps of Engineers (Corps) is conducting a study; the "West Shore, Lake Pontchartrain, Louisiana, Hurricane and Storm Damage Risk Reduction Feasibility Study" (WSLP) in Ascension, St. Charles, St. James, and St. John the Baptist Parishes, Louisiana, to determine the feasibility of providing Federal hurricane protection to the western shore of Lake Pontchartrain. The study was authorized by resolutions adopted by the U.S. House Committee on Public Works on July 29, 1971, and the U.S. Senate Committee on Public Works September 20, 1974. The Fish and Wildlife Service (Service) has prepared five Planning-aid Reports dated January 21, 1985, June 30, 1987, April 3, 1997, May 4, 2001, and October 9, 2012, for previous reconnaissance studies and one letter for a Notice of Intent dated January 9, 2009. The Service submits the following comments in accordance with the National Environmental Policy Act of 1969 (83 Stat. 852, as amended; 42 U.S.C. 4321 et seq.), the Migratory Bird Treaty Act (MBTA, 40 Stat. 755, as amended; 16 U.S.C. 703 et seq.), the Bald and Golden Eagle Protection Act (BGEPA) (54 Stat. 250, as amended, 16 U.S.C. 668a-d), the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.), and the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The study area is bounded by the Bonnet Carré Spillway to the east, the Mississippi River to the south, Lakes Pontchartrain and Maurepas to the north, and St. James Parish/Ascension Parish line to the west. The communities in this area include Laplace, Reserve, Gramercy, Lutcher, Garyville, Riverland Heights, and Carrollwood. The Louisiana Department of Wildlife and Fisheries manages the Maurepas Wildlife Management Area (WMA), which contains a majority of the swampland within the project area.

According to an August 2012 map provided by the Corps, there are three preliminary levee alignments which have been identified through previous reconnaissance and feasibility studies that are being considered for the Tentatively Selected Plan (TSP) (Figure 1). Generally, those alignments extend from the west guide levee of the Bonnet Carré Spillway to the vicinity of Hope Canal north of Garyville in St. John the Baptist Parish. Alignment A generally follows the wetland/non-wetland interface from LaPlace to Hope Canal. Alignment C generally follows an existing pipeline corridor north of Alignment A. Alignments A and C both tie into the Mississippi River levee. Alignment D generally follows the Interstate Highway 10 (I-10) corridor and extends outside the original study area into Ascension Parish to tie into an existing non-federal levee.

In the screening of the structural plans the planning team decided that it would not be feasible to either extend Alternative A or C into St. James Parish or create a ring levee to address the limited damages there in order to protect the entire study area. Non-Structural features have been added to Alternatives A and C that would provide for the elevation of structures and/or acquisition (when elevating structures higher than 13 feet is not implementable) to address remaining storm surge damages west of Hope Canal. Alternative E, a stand alone non-structural plan that would acquire

14,512 structures in the flood zones and address all of the damages in the study area was screened out.

Alternative C has been selected as the TSP that will move forward for further feasibility level development. Alternative C begins at the West Guide Levee of the Bonnet Carre Spillway and goes west to the US-51 Interchange where it turns north across US-51 and parallels along a pipeline transmission corridor. At I-10 near the Belle Terre exit, Alternative C crosses the interstate and follows the pipeline corridor through the wetlands until it reaches the St. John / St. James Parish line. At that point the alignment turns southward and extends to the location where the ground elevation is equal to or higher than the levee design crest elevation (near the Mississippi River Levee). This alignment was added to evaluate the feasibility of avoiding multiple of pipeline and utility crossings. The nonstructural component was added for areas west of Hope Canal.

The alignment consists largely of earthen levees, but does contain T-walls for crossings of roadways and pipelines. There are also a number of pump stations and environmental control structures associated with the alignment. The total distance of the alignment is estimated at 18.27 miles. There is a need for approximately 3,100,000 cubic yards of earthwork fill, 3,365,000 square yards of geotextile, nearly 26,000 cubic yards of aggregate limestone road, 5,300 linear feet of T-Walls, 300 linear feet of flood gates, 200 linear feet of drainage gates, and 2 railroad gates. There are 4 pumping stations associated with Alignment C. The levee system would primarily be a gravity drainage system with pumps operated only during storm events. With approximately 1.7 storm events per year the gravity drainage would be closed for approximately 8.5 days every year.

DESCRIPTION OF FISH AND WILDLIFE RESOURCE CONDITIONS

The dominant forested habitat types in the study area are bottomland hardwoods and swamp. Vegetation commonly found in these wetland areas includes sugarberry, red maple, sweetgum, American elm, black willow, green ash, overcup oak, Nuttall oak, and American sycamore in the bottomland hardwood habitat and baldcypress, tupelogum, blackgum, lizard's tail, swamp lily, buttonbush, swamp privet, and duckweeds in the swamp habitat. Scattered portions of upland hardwoods, scrub/shrub uplands, and scrub/shrub wetlands also are found along and within the developed areas. Except for Lake Pontchartrain, Lake Maurepas, and the Mississippi River, which border the study area, most of the open water within the study area consists mainly of tidal streams, canals, and ditches. The shallower open water areas may support submerged and/or floating aquatic vegetation such as coontail, pondweeds, naiads, fanwort, water hyacinth, pondweeds, American lotus, and widgeongrass.

Development for residential, commercial, and industrial purposes is located immediately adjacent to U.S. 61 and along the Mississippi River levee. Agriculture, primarily sugarcane production, is also extensive within that portion of the study area. Residential and commercial development is also becoming extensive between U.S. 61 and I-10, as wetlands are drained and/or filled to accommodate growth. Most of U.S. 61 and portions of I-10 are not elevated above the swamps they cross thus impacting the hydrology of those swamps. The wetland complex they cross is part of the largest contiguous wetland area in Louisiana.

The fresh and low-salinity water of the study area supports many commercially and recreationally important fishes such as largemouth bass, black crappie, sunfishes, catfishes, freshwater drum, buffalos, and gars. The low-salinity waters and wetlands of the study area also provide habitat for many species of estuarine-dependent fishes and shellfishes including southern flounder, sand seatrout, spotted seatrout, Atlantic croaker, striped mullet, Gulf menhaden, blue crab, and white shrimp. Decaying plant material (detritus) is carried by surface runoff and tidal action from the study area wetlands into the adjacent estuarine waters, substantially contributing to the detritus-based food web that supports a high level of estuarine-dependent finfish and shellfish productivity.

The coastal marshes and forested wetlands of the Lake Pontchartrain Basin have been identified by the North American Waterfowl Management Plan (NAWMP), Gulf Coast Joint Venture (GCLV): Mississippi River Coastal Wetlands Initiative as a key waterfowl wintering area. The Gulf Coast is the terminus of the Central and Mississippi Flyways and is therefore one of the most important waterfowl areas in North America, providing both wintering and migration habitat for significant numbers of the continental duck and goose populations that use both flyways. The Mississippi River Coastal Wetlands Initiative area is dominated by coastal marsh, forested swamps, and seasonally flooded bottomland hardwoods that provide habitat for several species of wintering waterfowl. Wood ducks are the primary waterfowl species in forested wetlands, while other ducks (e.g., mallard, American widgeon, gadwall, and lesser scaup) use those forested habitats to a lesser degree. One strategy to achieving the goals and objectives of the GCJV is to maintain the existing functions and values of those habitats and prevent additional losses and degradation of those wetlands (Wilson 2002). Numerous other game birds are present in or adjacent to the study area, including American coot, rails, gallinules, wood duck, common snipe, and American woodcock. Non-game bird species also utilize the study area marshes, including least bittern, pied-billed grebe, black-necked stilt, American avocet, killdeer, black-bellied plover, willet, and various species of sandpipers, gulls, and terns. The study area supports many resident and transient hawks and owls including red-shouldered hawk, barn owl, common screech owl, great horned owl, and barred owl. Winter residents include red-tailed hawk, northern harrier, and American kestrel, while the Mississippi kite, swallow-tailed kite and broad-winged hawk are common summer residents. In addition, the project area supports many species of resident and migratory passerine birds. Some neo-tropical migrants that are currently experiencing a population decline (e.g., white-eyed vireo, northern parula) are dependent on large forested acreage to successfully reproduce. Also, present are cuckoos, swifts, hummingbirds, nighthawks, woodpeckers, and the belted kingfisher.

Important game mammals occurring in the project area include white-tailed deer, eastern cottontail, swamp rabbit, gray squirrel, and fox squirrel. Commercially important furbearers include muskrat, nutria, river otter, raccoon, and mink. Other mammals expected include various species of insectivores, bats, rodents, and the nine-banded armadillo.

Numerous amphibians are expected to occur on stream and lake edges, ponds, and in forested wetlands of the study area including lesser siren, three-toed amphiuma, Gulf Coast toad, eastern narrow-mouthed toad, spring peeper, green treefrog, cricket frog, and bullfrog. Commercially important reptiles found in the streams, canals, and open water areas include American alligator, snapping turtle, alligator snapping turtle, smooth softshell turtle, spring softshell turtle, and diamondback terrapin. Other reptiles commonly found in the project area include red-eared turtle, painted turtle, Mississippi mud turtle, stinkpot, green anole, broad-headed skink, various water snakes, western ribbon snake, speckled kingsnake, and the western cottonmouth.

Threatened and Endangered Species

The Gulf sturgeon (*Acipenser oxyrhynchus desotoi*), federally listed as a threatened species, is an anadromous fish that occurs in many rivers, streams, and estuarine waters along the northern Gulf coast between the Mississippi River and the Suwannee River, Florida. In Louisiana, Gulf sturgeon have been reported at Rigolets Pass, rivers and lakes of the Lake Pontchartrain basin, and adjacent estuarine areas. Spawning occurs in coastal rivers between late winter and early spring (i.e., March to May). Adults and sub-adults may be found in those rivers and streams until November, and in estuarine or marine waters during the remainder of the year. Sturgeon less than two years old appear to remain in riverine habitats and estuarine areas throughout the year, rather than migrate to marine waters. Habitat alterations such as those caused by water control structures that limit and prevent spawning, poor water quality, and over-fishing have negatively affected this species.

On March 19, 2003, the Service and the National Marine Fisheries Service (NMFS) published a final rule in the Federal Register (Volume 68, No. 53) designating critical habitat for the Gulf sturgeon in Louisiana, Mississippi, Alabama, and Florida. Portions of the Pearl and Bogue Chitto Rivers, Lake Pontchartrain east of the Lake Pontchartrain Causeway, all of Little Lake, The Rigolets, Lake St. Catherine, and Lake Borgne within Louisiana were included in that designation. While sturgeon have been documented in study area waterways, those waterways are not designated critical habitat.

Federally listed as an endangered species, West Indian manatees (*Trichechus manatus*) occasionally enter Lakes Pontchartrain and Maurepas, and associated coastal waters and streams during the summer months (i.e., June through September). Manatee occurrences appear to be increasing, and they have been regularly reported in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, and in canals within the adjacent coastal marshes of Louisiana. They have also been occasionally observed elsewhere along the Louisiana Gulf coast. The manatee has declined in numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide may also adversely affect these animals. Should the proposed project involve activity in the aquatic environment in those areas during summer months, further consultation with this office will be necessary.

Migratory Bird Treaty Act (MBTA) and Bald and Golden Eagle Protection Act (BGEPA)

The proposed project area forested wetlands may provide nesting habitat for the bald eagle (*Haliaeetus leucocephalus*), which was officially removed from the List of Endangered and Threatened Species as of August 8, 2007. However, the bald eagle remains protected under the MBTA and BGEPA. There are approximately 28 known bald eagle nests in the study area. Comprehensive bald eagle survey data have not been collected by the Louisiana Department of Wildlife and Fisheries (LDWF) since 2008, and new active, inactive, or alternate nests may have been constructed within the proposed project area since that time. Bald eagles typically nest in large trees located near coastlines, rivers, or lakes that support adequate foraging from October through mid-May. In southeastern Louisiana parishes, eagles typically nest in mature trees (e.g., baldcypress, sycamore, willow, etc.) near fresh to intermediate marshes or open water.
During any project construction, on-site personnel should be informed of the possible presence of nesting bald eagles in the vicinity of the project boundary, and should identify, avoid, and immediately report any such nests to this office. If a bald eagle nest occurs or is discovered within 1,500 feet of the proposed project area, then an evaluation must be performed to determine whether the project is likely to disturb nesting bald eagles. That evaluation may be conducted on-line at: http://www.fws.gov/southeast/es/baldeagle. Following completion of the evaluation, that website will provide a determination of whether additional consultation is necessary.

The proposed project would be located in an area where colonial nesting waterbirds may be present. There are approximately 6 known nesting bird colonies in the study area. Colonies may be present that are not currently listed in the database maintained by LDWF. That database is updated primarily by monitoring the colony sites that were previously surveyed during the 1980s. Until a new, comprehensive coast-wide survey is conducted to determine the location of newly-established nesting colonies, we recommend that a qualified biologist inspect the proposed work site for the presence of undocumented nesting colonies during the nesting season. To minimize disturbance to colonial containing nesting wading birds (i.e., herons, egrets, night-herons, ibis, and roseate spoonbills), anhingas, and/or cormorants, all activity occurring within 1,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 1 through February 15, exact dates may vary within this window depending on species present). In addition, we recommend that on-site contract personnel be informed of the need to identify colonial nesting birds and their nests, and should avoid affecting them during the breeding season.

Management Areas

The LDWF operates two state wildlife management areas (WMAs) in the project vicinity including Maurepas Swamp WMA which encompasses over 100,000 acres of wetlands in and around the study area and Manchac WMA protecting over 7,000 acres of wetlands located in the northern tip of the study area. Both WMAs may be considered for mitigation of unavoidable direct and indirect impacts of swamp. Please contact the LDWF, Region 7 Office (225/765-2360), for further information regarding any additional permits that may be required to perform work on that WMA.

In addition, two federally approved wetland mitigation banks are located within the study area including the Sawgrass Bayou Mitigation Area owned by Blind River Properties (Mr. Dale Martin, 225/698-2700), and Lake Maurepas Mitigation Area owned by Stream Properties, LLC (Mr. Jeff Peterson, 337/433-1055, ext. 20). If the proposed project entails work within or adjacent to those bank sites, or if an alternative could potentially alter the hydrology of those sites, then the bank sponsors and the mitigation interagency review team should be contacted.

There is one Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) project, River Reintroduction into Maurepas Swamp (PO-29) currently in Phase I in the study area. Any potential impacts to this CWPPRA project would need to be addressed.

Subsidence, sea level rise, and hydrologic modifications coupled with the isolation of project area wetlands from the natural overflow of the Mississippi River, that formerly sustained these wetlands, has begun to lead to the long-term degradation of the quality and quantity of project area wetlands. Projects such as the above CWPPRA have the goal of restoring some of the natural overflow processes.

EVALUATION METHODOLOGY

To expedite the planning process, and be consistent with the new Corps SMART Planning Procedures, impacts were preliminarily determined utilizing existing information about the project area from the Coastwide Reference Monitoring System (CRMS) as a surrogate for habitat quality. Feasibility-level habitat analysis using Wetland Value Assessment (WVA) methodology should be conducted on the TSP, per the SMART Planning procedures, following release of the draft Integrated EIS and Feasibility Report for public review and be included in the final Integrated EIS and Feasibility Report.

The following information is taken from the CRMS Site Level Report Cards for sites CRMS0059, CRMS5373, CRMS0039, CRMS5167, and CRMS0065 (Louisiana Office of Coastal Protection and Restoration, 2013) and was used for assessment of wetland impacts.

The CRMS Site Level Report Card presents two ecological parameters that have been developed: a floristic quality index (FQI) and hydrologic index (HI). CRMS Analytical Teams, made up of agency and academic personnel, developed these indices, and others, based on the suite of parameters available from the 2006 to 2009 CRMS dataset. The FQI is used throughout the world to determine wetland quality based on plant species composition for a geographic area of interest. The FQI developed with the CRMS data is specific to coastal Louisiana. The FQI scores from 0 to 100 are calculated for a sampling station and are based on the percent cover values and the Coefficient of Conservatism (CC score) of the species present (Cretini et al. 2012). The HI jointly assesses the suitability of two critical aspects of wetland hydrology, average salinity and percent time flooded, in maximizing vegetation primary productivity. The HI score (between 0 and 100) corresponds to the percent of maximum vegetation productivity expected to occur if the separate effects of salinity and inundation interact in a multiplicative fashion on vegetation productivity (Snedden and Swenson 2012).

Based on the CRMS locations in proximity of each alignment we used a combination of site CRMS0059 and CRMS5373 for Alternatives A and C and all five sites for Alternative D. We averaged the FQI for the years 2007-2012 of each set of sites by alternative, then converted the index number into a value from 0.1 to 1.0 and then did the same for the HI for years 2008-2012. Unfortunately the HI was unavailable for sites CRMS0059 and CRMS0065 because those sites did not meet salinity and/or water level data completeness threshold (70% per water year) in order to calculate an HI score. In that case the HI for Alternatives A and C were averaged only with CRMS0059 for years 2008-2012. Next we averaged the FQI and HI numbers to obtain a single value to represent the habitat quality for each alternative. It should be noted that the FQI is calculated on the herbaceous vegetation. The CRMS Analytical Teams have developed a Forested FQI but it is still undergoing peer review. Though the forested FQI would have been preferred we feel the herbaceous FQI will still be useful in the intent of this comparison. The results of this analysis are presented in Table 1. Alternative C (TSP) and Alternative A have the same average FQI and HI, which was greater than Alternative D.

Table 1. Hydro Index (HI) and Floristic Quality Index (FQI) Converted to Values Between 0.1-1.0 and Averaged for each Alternative in the Final Alternative Array. Taken from Coastwide Reference Monitoring System (CRMS) Site Level Report Cards for sites CRMS0059, CRMS5373, CRMS0039, CRMS5167, and CRMS0065 (Louisiana Office of Coastal Protection and Restoration, 2013).

Alternative	Hydro Index (HI)	Floristic Quality Index (FQI)	Average of HI + FQI
Alternative A and C	0.864	0.197859	0.53093
Alternative D	0.769285714	0.184509	0.476898

Although this simplified approach is not ideal for assessing habitat quality, given the shortened study schedule and limitation on data gathering we felt this data driven approach is better than any other option explored. It is expected that once the TSP is selected the habitat evaluation team (HET) will conduct full WVA analysis on the TSP.

PROJECT IMPACTS

Construction of Alternative C will result in the direct loss of approximately 775 acres of swamp and bottomland hardwoods (BLH) and encloses 8,424 acres of swamp habitat for a total of 9,199 acres of direct and indirect impacts (Table 2). Although Alternative C has a greatly reduced the number of total impacted acres compared to Alternative D (57,343 acres) it is still significantly greater than Alternative A (3,941 acres).

Table 2. West Shore Lake Pontchartrain Acres Impacted

Alternative	Direct Acres	Indirect Acres	Total Acres
Alternative A	377	3,564	3,941
Alternative C	775	8,424	9,199
Alternative D	1,115	56,228	57,343

Alternative C will provide levee protection for Laplace, Reserve, Garyville and nonstructural protection west of Hope Canal. This alternative is the second least environmentally damaging alternative while providing protection to the same communities in the study area. With Alternative C there could be some impacts to the Maurepas Swamp WMA and potentially some impacts to the CWPPRA River Reintroduction into Maurepas Swamp (PO-29) project. However, Alternative C avoids a myriad of pipeline and utility crossings and is expected provide additional storm water storage capacity for exceedence events (i.e. where a storm event is greater than the design elevation of the levee and overtopping or levee failure results) in the enclosed wetland area thus decreasing the flooding potential of nearby developed areas.

Preliminary hydrologic modeling indicates that the project design would have minimal changes to tidal flows or stages to protected-side swamps. To accomplish this, culverts would be included within the levee system along those presently unaltered areas in order to retain hydrologic connectivity between the protected and unprotected areas. Currently, these measures have not been fully developed and there is still uncertainty on whether maintaining existing flow/exchange can be achieved. The hydrologic modeling conducted addressed tidal exchange; however, tidal exchange is dampened that far inland from Lake Maurepas. In addition, elevations are greatest near the river and decrease toward the lake. Therefore, the protected side is primarily a run-off driven system. Interior drainage modeling has not yet been conducted to determine if the proposed levee would increase interior water levels and duration and frequency of swamp inundation.

Based on the 2008 to 2012 water level range data for stations CRMS0059 and CRMS5373 the swamps are temporarily flooded. Temporarily flooded is defined as surface water is present for brief periods during the growing season, but the water table usually lies well below the surface for most of the season. The wetlands of the study area that will be enclosed by the proposed levee alignment have moderate to low water flow/exchange due to the many berms (e.g., U.S. 61 and I-10) scattered throughout the area. Most of the flow is through existing canals and bayous. Maintaining existing flow/exchange may be possible if many of the existing openings are aligned with the proposed levee culverts. Because the existing berms will be at a lower elevation than the proposed levee, overbank flows will be eliminated.

In addition to the impact to water exchange in the protected-side swamp, the Service is concerned about reduced future water exchange due to Sea Level Rise (SLR) requiring increased structure closures. The frequency and duration of gate closures is expected to increase due to area-wide stage increases caused by relative SLR thereby leading to potential substantial affects to wetlands enclosed by the levee system. These potential impacts have not yet been fully determined; but are expected to be analyzed during the feasibility phase of the study. By the end of the period of analysis (i.e., 50 years), under the high SLR scenario, all gates could be closed all of the time, similarly under the intermediate SLR scenario there may be almost complete structure closures. At present, it is unknown how water levels within the system would be managed and there is a potential for substantial additional indirect impacts to swamp and fish and wildlife resources to occur.

If the proposed levee increases flood frequency and water depth the bald cypress swamp will become stressed which could result in a reduction in diversity and productivity (Krauss et. al. 2009). Increased water depth can also reduce the transfer of oxygen to roots. Over time, a stressed swamp could convert to marsh and/or open water. Reduced water exchange in the enclosed wetlands would lead to further water quality deterioration in the Lake Pontchartrain Basin by eliminating or reducing the filtering capacity of those wetlands. The potential wetland habitat impact to the largest remaining continuous forested wetlands in Louisiana would result in the reduction of resident fish and wildlife, reduced important wintering habitat for waterfowl and other migratory birds that use the Central and Mississippi Flyways, and reduced nursery habitat and detritus input important to the maintenance of estuarine-dependent fish and shellfish production

Developmental pressures on enclosed forested wetlands would likely increase with levee construction due to the reduced threat of flooding in the area but that would also be dependent on the proposed operation of pumps. According to the Corps Civil Works Program Five-Year Development Plan for Fiscal Year 2011 to Fiscal Year 2015, national flood damages are increasing and that is attributed to population migration to the coasts and development of floodplains, thus creating apparent contradiction between flood damage reduction investments and national flood damages (Corps of Engineers, 2011). Induced development of the protected-side wetlands would not be conducive with the Corps' plan to reduce flood damages and also utilize this area for flood storage capacity during storms exceeding the project design. Another apparent inconsistency between programs is the planning of restoration projects while at the same time levees are being proposed to enclose floodplain habitat and permits are issued for development in these floodplains. More consistency between these programs needs to address the conflicting approaches between restoration and future development. Therefore, the Corps and local sponsor should acquire adequate protection of the enclosed wetlands to ensure and maintain preservation of those areas in perpetuity via the purchase of non-development easements and local flood zoning ordinances.

It is expected that three potential borrow sources will be used for this project: the Bonnet Carre borrow area located north of Airline Highway in St. Charles Parish, Louisiana; the Big Shake borrow site located in St. James Parish, a 441-acre actively-farmed sugarcane fields between LA-44 and LA-3125 in a rural area; and the River Bend II borrow site located at LaPlace, St. John the Baptist Parish which is currently used for sugarcane farming and has 7.39 acres of non-wetland bottomland hardwood (BLH) habitat located within the proposed site. All three sites have environmental clearance. The Bonnet Carre site was documented in the 2007 "Final Phase I Environmental Site Assessment, Bonnet Carre Borrow Area, North of Airline Highway, St. Charles Parish, Louisiana." The Big Shake site is documented in the Greater New Orleans Hurricane and Storm Damage Risk Reduction System (HSDRRS) Individual Environmental Report (IER) 30 Decision Record dated September 2009. The River BendII site is documented in the HSDRRS IER 35 Decision Record dated October 2011. If the proposed project needs more borrow than the already environmentally cleared borrow sites please consider that the Corps has almost completed full implementation of the newly-authorized protection levels for hurricane and flood protection projects in the Greater New Orleans area. The combined need for borrow necessary to complete authorized flood protection improvements and construction of other proposed and implemented Federal and non-Federal hurricane and flood protection levees may have diminished local availability. The search for levee-building material has been conducted on a project-by-project basis, and has led to the least-expensive and easiest sources for borrow material, which is usually located within wetlands and/or bottomland hardwoods adjacent to the proposed levee. Use of such on-site sources often has adverse impacts on wetlands and is frequently inconsistent with coastal restoration efforts. Use of those sites will be counterproductive with respect to minimizing wetland impacts and attaining the goal of increasing non-structural hurricane protection within a sustainable ecosystem. The Service's priority selection process for borrow material outlined in our August 7, 2006, letter to the Corps regarding the Greater New Orleans Hurricane and Storm Damage Risk Reduction project should be utilized (Appendix A). The Service recommends further investigation of the identified potential borrow areas (map provided via a March 2013 email) that are likely to have minimal impacts to fish and wildlife areas identified on that map should be investigated first as potential borrow sources.

SERVICE POSITION AND RECOMMENDATIONS

The Service would prefer to see selection of the least environmentally damaging alterative which is Alternative A. However, we recognize and understand the logic and reasoning for selecting Alternative C, which includes avoidance of the costly relocation of pipelines and utilities and is expected to provide additional storm water storage capacity for exceedence events thus decreasing the flooding potential of nearby developed areas. Construction of Alternative C will result in the direct loss of approximately 775 acres of swamp and BLH and encloses 8,424 acres of valuable swamp habitat for a total of 9,199 acres of direct and indirect acres.

The Service's Mitigation Policy (Federal Register, Volume 46, No. 15, January 23, 1981) identifies four resource categories that are used to ensure that the level of mitigation recommended by Service biologists will be consistent with the fish and wildlife resource values involved. Considering the high value of forested wetlands for fish and wildlife and the relative scarcity of that habitat type, that habitat type is designated as Resource Category 2, the mitigation goal for which is no net loss of in-kind habitat value. The scrub-shrub habitat that may be impacted, however, is placed in Resource Category 3 due to their reduced value to wildlife, fisheries and degraded wetland functions. The mitigation goal for Resource Category 3 habitats is no net loss of habitat value.

The Service respectfully requests the following recommendations are implemented concurrently with project implementation:

1. Over 8,000 acres of swamp will be enclosed within the levee of Alternative C. The proposed alternative may alter natural periods of inundation or soil saturation in the impounded wetlands and could prove detrimental to their function and longevity. Interior drainage modeling has not yet been conducted to determine if the proposed levee would increase interior water levels and duration and frequency of swamp inundation. Therefore, the Service recommends;
    a. interior drainage modeling be conducted to determine effects of the project on water circulation, water levels, and inundation duration and frequency of protected-side swamps based on the proposed project features.
    b. the installation of sufficient culverts and water control structures in the levee that could be properly operated to ensure adequate water exchange (such structures should be closed only in advance of tropical storms).
    c. to aid in water quality improvements, the Service recommends that any pumping stations associated with the project should not discharge directly into canals or other open water bodies, but rather into wetland systems that can assimilate nutrients being discharged.
    d. The Service recommends hydrologic gauges be placed and maintained in appropriate locations to assist in determining future impacts to enclosed swamps. These gauges

could be supported through existing activities such as through the US Geological Survey (USGS) or CRMS.

2. Additional information is needed by the Service to complete the required evaluation of project effects and fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act. Much of that information will not be available until the feasibility phase of the project has progressed. To help ensure that sufficient information is provided, the Service recommends that the Corps perform the following tasks during the feasibility phase. Provide additional information on anticipated construction details, such as structure size and locations, operation plan of structures, hydrologic (drainage) impacts to interior wetlands as a result of the levee including water level changes and projections of relative SLR on frequency and duration of structure closures.

3. Operational plans for floodgates and water control structures should be developed to maximize the open cross-sectional area for as long as possible. Development of water control structure operation manuals or plans should be done in coordination with the Service and other natural resource agencies.

4. The Service recommends preservation of enclosed wetlands be ensured (in perpetuity) via the purchase of non-development easements and local flood zoning ordinances. Providing perpetual preservation of enclosed wetlands would also guarantee flood storage areas within the levee system.

5. Alternative C could potentially have impacts to the CWPPRA River Reintroduction into Maurepas Swamp (PO-29) project. The Service recommends close coordinate with the planning objectives and planning team of the restoration project and that any potential impacts to this CWPPRA project be addressed.

6. If it becomes necessary to use borrow sources other than the previously proposed environmentally cleared sites, the Service recommends investigating potential borrow sources based on the map identifying potential borrow areas that are likely to have minimal impacts to fish and wildlife resources that we provided, via a September 9, 2008, letter and based on our priority selection process for borrow material outlined in our August 7, 2006, letter to the Corps regarding the Greater New Orleans Hurricane and Storm Damage Risk Reduction project (Appendix A) should be utilized (please contact Cathy Breaux (504)862-2689 or David Walther (337)291-3122 for more information).

7. The enclosure of wetlands within the proposed levee is necessary to avoid pipeline and utility relocations and to provide for floodwater storage. Full, in-kind compensation (quantified as Average Annual Habitat Units) should be provided for unavoidable direct (levee footprint) adverse impacts and indirect habitat value losses (enclosed wetlands) on forested wetlands associated with levee construction, including any additional losses identified during the feasibility phase and engineering and design studies. Detailed mitigation needs should be determined in the feasibility stage. Mitigation planning, including site selection and design, should be closely coordinated with the Service, LDWF, and other interested natural resource agencies. To help ensure that the proposed mitigation features meet their goals, the Service provides the following recommendations.
    a. If applicable, a General Plan should be developed by the Corps, LDWF, and the Service in accordance with Section 3(b) of the Fish and Wildlife Coordination Act for mitigation lands.
    b. Mitigation should, to the greatest extent practical, include potential mitigation sites and features on the nearby Maurepas WMA previously provided by LDWF (Appendix B).
    c. Mitigation measures should be constructed concurrently with the flood damage reduction features that they are mitigating (i.e., mitigation should be completed no later than 18 months after levee construction has begun). Completion of mitigation means that success criteria have been achieved. If a portion of the mitigation is provided via a mitigation bank, completed mitigation would be achieved when credits are purchased from an approved mitigation bank and documentation of credit is provided to the resource agencies.
    d. The Service and LDWF recommend the Maurepas WMA be used to the greatest extent practical for in-kind mitigation and at a minimum, all impacts to the Maurepas WMA should be mitigated for on the WMA. Because adequate and appropriate mitigation is available both on the WMA and through approved mitigation banks, use of in-lieu fee mitigation is not recommended.
    e. If mitigation is not implemented concurrent with levee construction, the amount of mitigation needed should be reassessed and adjusted to offset temporal losses of wetlands.
    f. The Corps should remain responsible for the required mitigation until the mitigation is demonstrated to be fully compliant with success and performance criteria. At a minimum, this should include compliance with the requisite vegetation, elevation, acreage, and dike gapping criteria.
    g. The acreage restored and/or managed for mitigation purposes, and adjacent affected wetlands, should be monitored over the project life. This monitoring should be used to evaluate project impacts, the effectiveness of the compensatory mitigation measures, and the need for additional mitigation should those measures prove insufficient.

8. The Service recommends enough money be set aside for adaptive management to address potential impacts of the enclosed wetlands and the adjacent CWPPRA River Reintroduction into Maurepas Swamp (PO-29) project. The Service, LDWF, and other natural resource agencies should be consulted in the development of plans and specifications for all mitigation features and any monitoring and/or adaptive management plans. In addition the Service recommends the Monitoring and Adaptive Management Plan, as it is further developed, be provided to the Service, NMFS, and LDWF for review, comment, and input.

9. Alignment C will occur partly within the boundaries of Maurepas Swamp WMA. Please coordinate all activities within the WMA with LDWF. Please contact Mr. Christain Winslow (985-543-4781 or cwinslow@wlf.la.gov) and Mr. Mike Windham at 504-284-5268 or cwindham@wlf.la.gov for more information about appropriate WMA authorizations.

10. Blind River is a Louisiana designated Natural and Scenic River. The Corps must obtain authorization from the LDWF, Scenic Rivers Program prior to initiating any of the proposed activities within or adjacent to the banks of Blind River. Scenic Rivers Coordinator Keith Cascio can be contacted at (318) 343-4045 or kcascio@wlf.la.gov.

11. Unavoidable impacts to wetlands within Maurepas WMA should be mitigated on the WMA, including those associated with fisheries, wildlife passage, and recreational use of the Maurepas WMA.

12. Should long segments of levee be topped with T or I-walls, the Service and LDWF recommend wildlife crossings be provided so as to prevent barriers to wildlife movement.

13. The Corps should coordinate closely with the Service, LDWF, and other fish and wildlife conservation agencies throughout the feasibility, pre-construction engineering, and design phase of project features including levees, floodgates, and environmental water control structures to ensure that those features are designed, constructed and operated consistent with wetland restoration purposes and associated fish and wildlife resource needs, and to update and finalize impacts and to develop an adequate mitigation plan.

14. West Indian manatees (*Trichechus manatus*) occasionally enter Lakes Pontchartrain and Maurepas, and associated coastal waters and streams during the summer months (i.e., June through September). During in-water work in areas that potentially support manatees all personnel associated with the project should be instructed about the potential presence of

manatees, manatee speed zones, and the need to avoid collisions with and injury to manatees. All personnel should be advised that there are civil and criminal penalties for harming, harassing, or killing manatees which are protected under the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. Additionally, personnel should be instructed not to attempt to feed or otherwise interact with the animal, although passively taking pictures or video would be acceptable. For more detail on avoiding contact with manatee contact this office. Should a proposed action directly or indirectly affect the West Indian manatee, further consultation with this office will be necessary.

15. Avoid adverse impacts to nesting bald eagles and wading bird colonies through careful design project features and timing of construction. The Service and LDWF recommends that a qualified biologist inspect the proposed work site for the presence of undocumented nesting colonies and bald eagles during the nesting season (i.e., September 1 through February 15 for wading bird nesting colonies and October through mid-May for bald eagles).

16. If proposed project features, including adaptive management features, are changed significantly or are not implemented within one year of the Endangered Species Act consultation letter, we recommend that the Corps reinitiate coordination with the Service and NMFS to ensure that the proposed project would not adversely affect any Federally listed threatened or endangered species or their critical habitat.

Given that design and evaluation of most project features has been at a programmatic level, the Service cannot fulfill its Coordination Act responsibilities at this time. We hope to complete the assessment of impacts in time for inclusion in the Final Environmental Impact Statement. To complete those assessments, we may require additional funding during the next several months. Estimates of those funding needs should be coordinated in advance with the Service, and should be based on the nature and complexity of issues associated with the project design and implementation. For those features that undergo additional design work during the Pre-construction and design phase (PED) the Corps should coordinate that work with the Service and other natural resource agencies in accordance with the FWCA. Funding for such work may also be necessary.

We appreciate the Corps' consideration of our recommendations for further development of a TSP for the proposed project. Provided that the above recommendations are included in the final feasibility report and related authorizing documents, the Service does not oppose further planning of the TSP. Should you or your staff have any questions, or if you would like to meet with us regarding the content of this letter, please contact Mrs. Catherine Breaux (504/862-2689) of this office.

LITERATURE CITED

Cretini, K.F., Visser, J.M., Krauss, K.W., and Steyer, G.D. (2012). Development and use of floristic quality index for coastal Louisiana marshes. Environmental Monitoring and Assessment 184:2389-2403.

Department of the Army, U.S. Army Corps of Engineers Civil Works Program Five-Year Development Plan for Fiscal Year 2011 to Fiscal Year 2015, 145 pages. http://www.usace.army.mil/Portals/2/docs/civilworks/5yr_devplan/fy11_5yrplan.pdf

Krauss, K.W., Duberstein, J.A., Doyle, T.W., Conner, W.H., Day, R.H., Inabinette, L.W., and Whitbeck J.L., 2009. Site Condition, Structure, and Growth of Baldcypress Along Tidal/Non-Tidal Salinity Gradients. Wetlands, Vol. 29, No. 2, June 2009, pp. 505–519.

Snedden, G.A., and Swenson, E.M., 2012, Hydrologic index development and application to selected Coastwide Reference Monitoring System sites and Coastal Wetlands Planning, Protection and Restoration Act projects: U.S. Geological Survey Open-File Report 2012–1122, 25 p.

Louisiana Office of Coastal Protection and Restoration. 2013. Coastwide Reference Monitoring System-Wetlands Monitoring Data. Retrieved from Strategic Online Natural Resource Information System (SONRIS) database. http://coastal.louisiana.gov/index.cfm?md=pagebuilder&tmp=home&pid=92 Accessed 09 May 2013.

Wilson, B.C., C.A. Manlove, and C.G. Esslinger. 2002. North American Waterfowl Management Plan, Gulf Coast Joint Venture: Mississippi River Coastal Wetlands Initiative. North American Waterfowl Management Plan, Albuquerque, NM. 28 pp. + appendix.

Appendix A

The Service's priority selection process for borrow material as outlined in our August 7, 2006, letter to the Corps

This information is provided in accordance with the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.), Fish and Wildlife Coordination Act (FWCA, 48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and the Migratory Bird Treaty Act (40 Stat. 755, as amended; 16 U.S.C. 703 et seq.).

Through the efforts of Task Force Guardian, the Corps restored Hurricane Katrina-damaged hurricane/flood protection projects to their authorized or previously permitted/constructed protection levels. Identification of borrow areas needed to complete those repairs utilized a protocol that prioritized selection of those sites in the following order: existing commercial pits, upland sources, previously disturbed/manipulated wetlands within a levee system, and low-quality wetlands outside a levee system. The Service supports the use of such protocols to avoid and minimize impacts to wetlands and bottomland hardwoods within project areas. Avoidance and minimization of those impacts helps to provide consistency with restoration strategies and compliments the authorized hurricane protection efforts. Such consistency is also required by Section 303(d)(1) of the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA).

Accordingly, the Service recommends that prior to utilizing borrow sites every effort should be made to reduce impacts by using sheetpile, floodwalls or deep soil mixing to decrease levee widths wherever feasible. In addition, the Service recommends that the following protocol be adopted and utilized to identify borrow sources in descending order of priority:

1. Permitted commercial sources, authorized borrow sources for which environmental clearance and mitigation have been completed, or non-functional levees after newly constructed adjacent levees are providing equal protection.

2. Areas under forced drainage that are protected from flooding by levees, and that are:

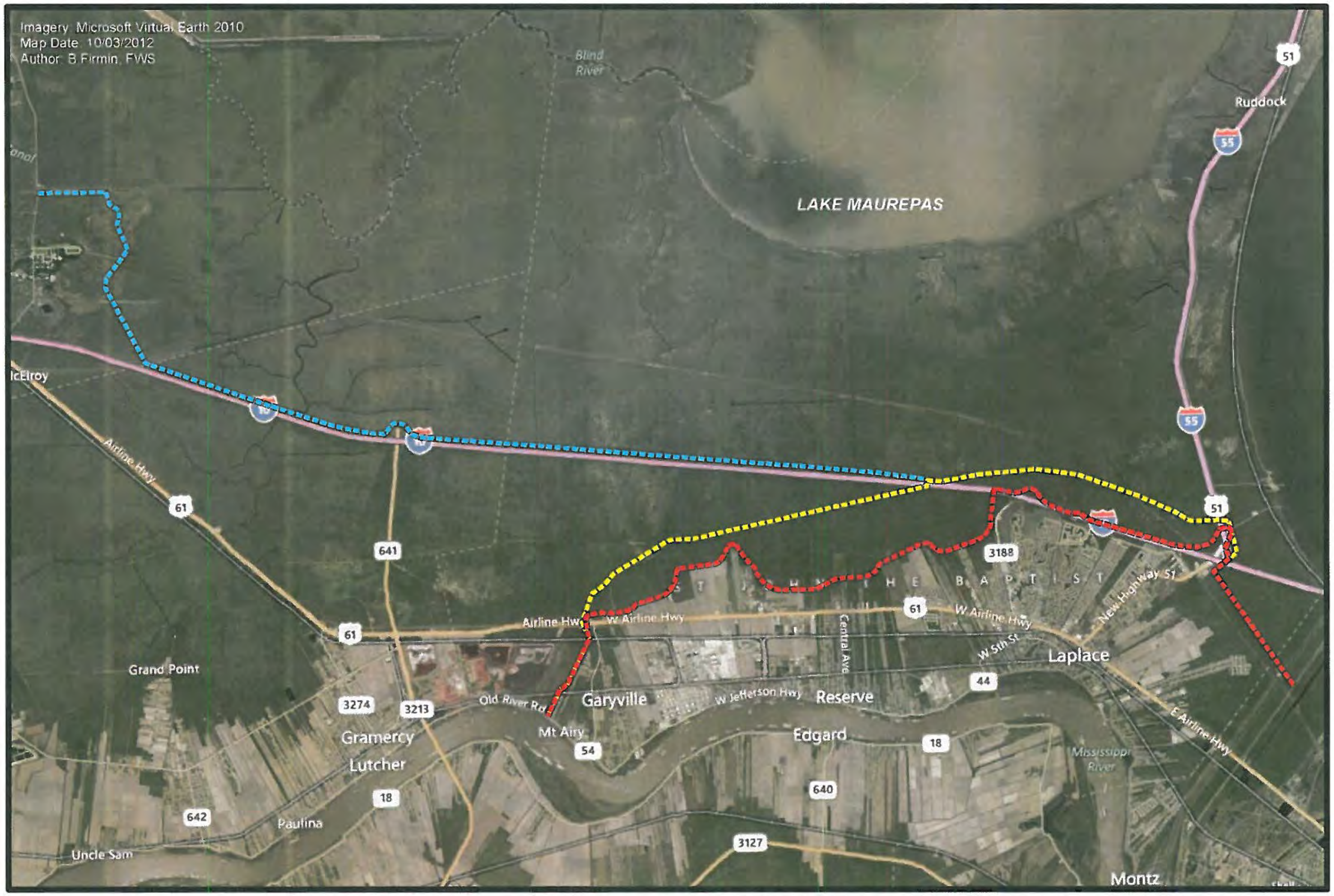
   a) non-forested (e.g., pastures, fallow fields, abandoned orchards, former urban areas) and non-wetlands;

   b) wetland forests dominated by exotic tree species (i.e., Chinese tallow-trees) or non-forested wetlands(e.g., wet pastures), excluding marshes;

   c) disturbed wetlands (e.g., hydrologically altered, artificially impounded).

3. Sites that are outside a forced drainage system and levees, and that are:

Figure 1. Proposed alignments for the West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Study



West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Study

N W E S

Alignment_A   Alignment_C   Alignment_D

Appendix B

DRAFT Maurepas Swamp WMA Mitigation Proposals
Prepared by the Louisiana Department of Wildlife and Fisheries (LDWF)
Presented to the West Shore-Lake Pontchartrain Project Delivery Team (PDT)
May 23, 2013

The elimination of nutrient and freshwater inputs threatens the sustainability of the Maurepas Swamp. The most effective strategy to restore health and productivity of the swamp is construction of Mississippi River reintroductions into Maurepas Swamp. However, additional measures such as eliminating barriers to surface flow patterns are also needed, not only to compliment the planned river reintroductions, but also to improve current hydrologic conditions. Therefore, the mitigation measures identified below by LDWF primarily aim to enhance or improve surface hydrology until such time that river reintroductions are constructed. The mitigation measures are still conceptual and will require further planning and engineering. LDWF also prioritized each measure (i.e., High, Medium or Low) to inform the PDT on which measures are believed to be most beneficial.

1. Gap spoil banks along Reserve Relief Canal (**High priority**).

2. Gap spoil banks along New River Canal (**High priority**).

3. Gap/degrade railroad bed which traverses the swamp beginning from Hope Canal and proceeding north and west to the northern property boundary (crossing Blind River and Amite River Diversion Canal (**High priority**).

4. Improve through flow of Hammond wastewater into existing Joyce WMA outfall area (**High priority**).

5. Make efficient use of stormwater and wastewater produced by communities south of I-10 (e.g., Laplace, Ascension Parish) by distributing this water into the Maurepas Swamp (**High priority**).

6. Diversion of freshwater from Bonnet Carre Spillway guide levee to the swamps and marshes to the northwest (**Medium priority**).

7. Gap any spoil banks north of I-10 in the area of Tennessee Williams (**Medium priority**).

8. Preserve existing wetlands by acquiring land in fee title that is enclosed within the levee (**Low priority**).

9. Restrict development in wetlands enclosed within the levee (**Low priority**).

The number of the proposed mitigation measure corresponds with the number on the accompanying map.

a) non-forested (e.g., pastures fallow fields, abandoned orchards, former urban areas) and non-wetlands;

b) wetland forests dominated by exotic tree species (i.e., Chinese tallow-trees) or non-forested wetlands(e.g., wet pastures), excluding marshes;

c) disturbed wetlands (e.g., hydrologically altered, artificially impounded).

Notwithstanding this protocol, the location, size and configuration of borrow sites within the landscape is also critically important. Coastal ridges, natural levee flanks and other geographic features that provide forested/wetland habitats and/or potential barriers to hurricane surges should not be utilized as borrow sources, especially where such uses would diminish the natural functions and values of those landscape features.

To assist in expediting the identification of borrow sites, the Service recommends that immediately after the initial identification of a new borrow site the Corps should initiate informal consultation with the Service regarding potential impacts to federally listed threatened or endangered species. To aid you in complying with those proactive consultation responsibilities, the Service has enclosed a list of threatened and endangered species and their critical habitats within the coastal parishes of the New Orleans District.

The Service offers the following additional recommendations for reducing borrow site impacts on fish and wildlife resources and, where feasible, enhancing those resources. However, these additional recommendations should not be implemented if they would result in the expansion of existing borrow pits or construction of new borrow pits in wetlands or bottomland hardwoods.

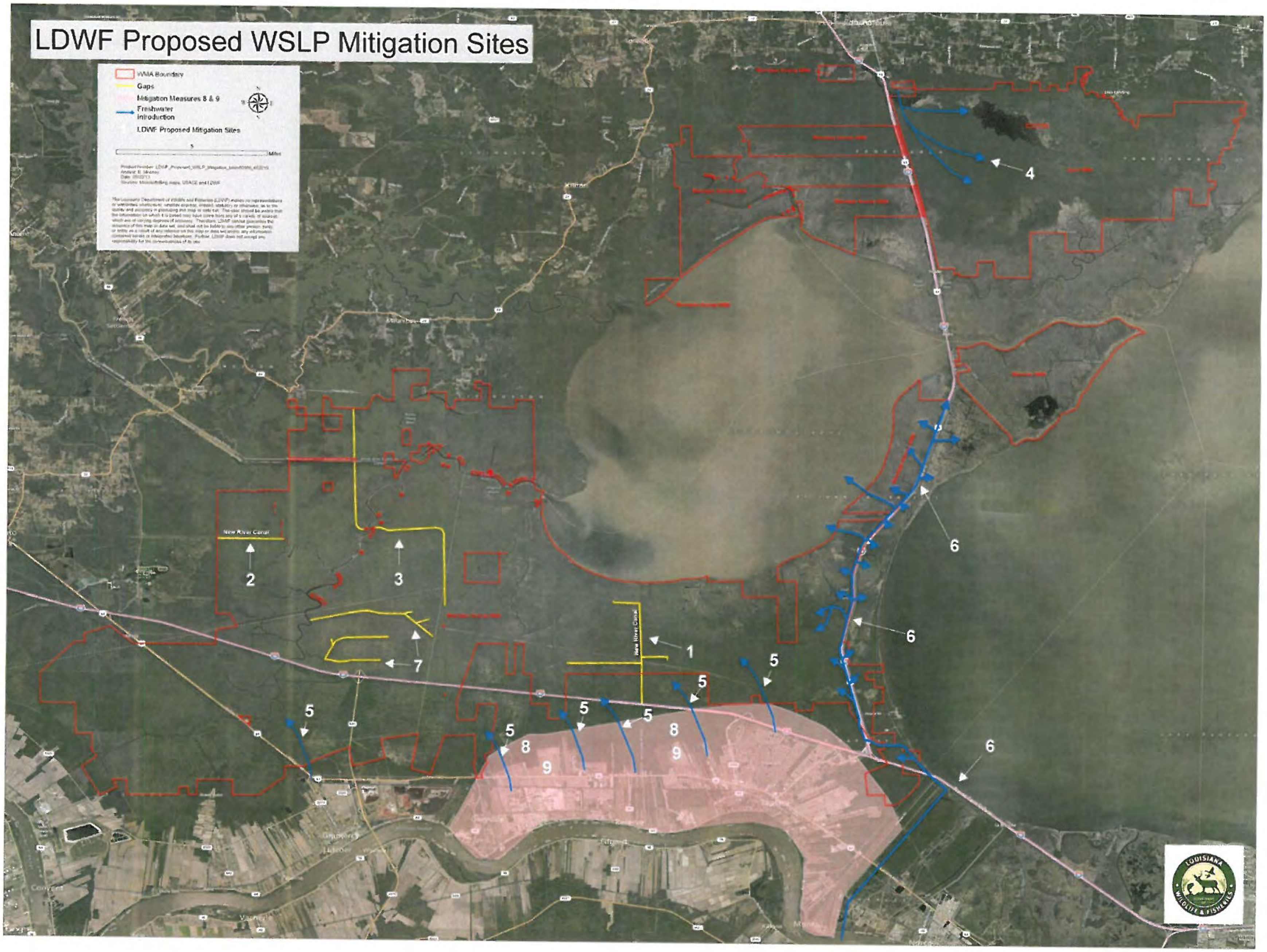
1. A minimum of 30 percent of the borrow pits edge should slope no greater than 5 horizontal (H):1 vertical (V), starting from the water line down to a depth of approximately 5 feet.

2. Most of the woody vegetation removed during clearing and grubbing should be placed into the deepest parts of the borrow pits and the remaining debris should be placed in the water along the borrow pit shorelines, excluding those areas where the 5H:1V slope, per recommendation 1, have been constructed.

3. Following construction, perimeter levees (if constructed) around each borrow pit should be gapped at 25-foot intervals with an 8-foot-wide breach, the bottom elevation of which should be level with the adjacent natural ground elevation.

When avoidance and minimization of bottomland hardwood and wetland impacts is not practicable, all unavoidable net losses of those habitats should be fully offset via compensatory mitigation. Such compensatory mitigation should sited within the watershed and/or hydrologic unit where the impact occurred, and should be completed concurrently with borrow operations, or as soon thereafter as possible.

LDWF Proposed WSLP Mitigation Sites



United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

June 5, 2013

Mr. Richard Hartman
Branch Chief
Habitat Conservation Division
National Marine Fisheries Service
c/o Louisiana State University
Baton Rouge, Louisiana 70803-7535

Dear Mr. Hartman:

Attached is the Draft Fish and Wildlife Coordination Act Report on the "West Shore, Lake Pontchartrain, Louisiana, Hurricane and Storm Damage Risk Reduction Feasibility Study." This report does not constitute the 2(b) report of the Fish and Wildlife Service (Service). The Service will incorporate your agency's comments into the final report prior to its submission to the U.S. Army Corps of Engineers. Should your staff have any questions regarding this report, please have them contact Catherine Breaux (504/862-2689) of this office.

Sincerely,

Jeffrey D. Weller
Supervisor
Louisiana Ecological Services Office

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

June 5, 2013

Robert Barham
Secretary
Louisiana Department of Wildlife and Fisheries
Post Office Box 98000
Baton Rouge, Louisiana 70898-9000

Dear Mr. Barham:

Attached is the Draft Fish and Wildlife Coordination Act Report on the "West Shore, Lake Pontchartrain, Louisiana, Hurricane and Storm Damage Risk Reduction Feasibility Study." This report does not constitute the 2(b) report of the Fish and Wildlife Service (Service). The Service will incorporate your agency's comments into the final report prior to its submission to the U.S. Army Corps of Engineers. Should your staff have any questions regarding this report, please have them contact Catherine Breaux (504/862-2689) of this office.

Sincerely,

Jeffrey D. Weller
Supervisor
Louisiana Ecological Services Office

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A
Annex H

U.S. Fish and Wildlife Service Scoping / Planning Aid Letter

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

January 9, 2009

Colonel Alvin B. Lee
District Engineer
Attention: Mr. Bill Klein, CEMVN-PM-RS
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Lee:

The U.S. Fish and Wildlife Service (Service) has reviewed the Department of the Army, Corps of Engineers (Corps), Notice of Intent (NOI) to prepare a Draft Environmental Impact Statement (DEIS) for the West Shore, Lake Pontchartrain, Louisiana, Hurricane and Storm Damage Risk Reduction Feasibility Study. The NOI was published in the Federal Register (Volume 73, No. 235, pg. 74150) on December 5, 2008 (Department of Interior No. ER86/1259). The study was authorized by resolutions adopted by the House Committee on Public Works on July 29, 1971, and the Senate Committee on Public Works September 20, 1974. The Fish and Wildlife Service has prepared three Planning-aid Reports dated January 21, 1985, June 30, 1987, and April 3, 1997, for previous reconnaissance studies on this proposed project. The Service submits the following comments in accordance with the National Environmental Policy Act of 1969 (83 Stat. 852, as amended; 42 U.S.C. 4321 et seq.), the Migratory Bird Treaty Act (MBTA, 40 Stat. 755, as amended; 16 U.S.C. 703 et seq.), the Bald and Golden Eagle Protection Act (BGEPA) (54 Stat. 250, as amended, 16 U.S.C. 668a-d), the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.), and the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The Corps is conducting a study to determine the feasibility of providing Federal hurricane protection to the western shore of Lake Pontchartrain. Four preliminary levee alignments have been identified through previous reconnaissance and feasibility studies. Generally, those alignments extend from the west guide levee of the Bonnet Carré Spillway to the vicinity of Hope Canal north of Garyville in St. John the Baptist Parish, with one alternative alignment extending into Ascension Parish to tie into an existing non-federal levee. The study area is bounded by the Bonnet Carré Spillway to the east, the Mississippi River to the south, Lakes Pontchartrain and Maurepas to the north, and St. James Parish/Ascension Parish line to the west.

DESCRIPTION OF FISH AND WILDLIFE RESOURCE CONDTIONS

DESCRIPTION OF FISH AND WILDLIFE RESOURCE CONDTIONS

The dominant forested habitat types in the study area are bottomland hardwoods and swamp. Vegetation commonly found in these wetland areas includes sugarberry, red maple, sweetgum, American elm, black willow, green ash, overcup oak, Nuttall oak, and American sycamore in the bottomland hardwood habitat and baldcypress, tupelogum, blackgum, lizard's tail, swamp lily, buttonbush, swamp privet, and duckweeds in the swamp habitat. Scattered portions of upland hardwoods, scrub/shrub uplands, and scrub/shrub wetlands also are found along and within the developed areas. Except for Lake Pontchartrain, Lake Maurepas, and the Mississippi River, which border the study area, most of the open water within the study area consists mainly of tidal streams, canals, and ditches. The shallower open water areas may support submerged and/or floating aquatic vegetation such as coontail, pondweeds, naiads, fanwort, water hyacinth, pondweeds, American lotus, and widgeongrass.

Development for residential, commercial, and industrial purposes is located immediately adjacent to U.S. 61 and along the Mississippi River levee. Agriculture, primarily sugarcane production, is also extensive within that portion of the study area. Residential and commercial development is also becoming extensive between U.S. 61 and I-10, as wetlands are drained and/or filled to accommodate growth.

The fresh and low-salinity water of the study area supports many commercially and recreationally important fishes and shellfishes such as largemouth bass, black crappie, sunfishes, catfishes, freshwater drum, buffalos, and gars. The low-salinity waters and wetlands of the study area also provide habitat for many species of estuarine-dependent fishes and shellfishes including southern flounder, sand seatrout, spotted seatrout, Atlantic croaker, striped mullet, Gulf menhaden, blue crab, and white shrimp. Decaying plant material (detritus) is carried by surface runoff and tidal action from the study area wetlands into the adjacent estuarine waters, substantially contributing to the detritus-based food web that supports a high level of estuarine-dependent finfish and shellfish productivity.

The coastal marshes and forested wetlands of the Lake Pontchartrain Basin have been identified by the North American Waterfowl Management Plan (NAWMP), Gulf Coast Joint Venture (GCLV): Mississippi River Coastal Wetlands Initiative as a key waterfowl wintering area. The Gulf Coast is the terminus of the Central and Mississippi Flyways and is therefore one of the most important waterfowl areas in North America, providing both wintering and migration habitat for significant numbers of the continental duck and goose populations that use both flyways. The Mississippi River Coastal Wetlands Initiative area is dominated by coastal marsh, forested swamps, and seasonally flooded bottomland hardwoods that provide habitat for several species of wintering waterfowl. Wood ducks are the primary waterfowl species in these forested wetlands, while other ducks (e.g., mallard, American widgeon, gadwall, and lesser scaup) use these habitats to a lesser degree. One strategy to achieving the goals and objectives of the GCJV is to maintain the existing functions and values of those habitats and prevent additional losses and degradation of those wetlands (Wilson 2002). Numerous other game birds are present in or adjacent to the study area, including American coot, rails, gallinules, wood duck, common snipe, and American woodcock. Non-game bird species also utilize the study area marshes, including least bittern, pied-billed grebe, black-necked stilt, American avocet, killdeer, black-bellied plover, willet, and various species of sandpipers, gulls, and terns. The study area supports many resident and transient hawks and owls including red-shouldered hawk, barn owl, common screech owl, great horned owl, and barred owl. Winter residents include red-tailed hawk, northern harrier, and American kestrel, while the Mississippi kite, swallow-tailed kite and broad-winged hawk are common summer residents. In addition, the project area supports many species of resident and migratory passerine birds. Some neo-tropical migrants that are currently experiencing a population decline (e.g., white-eyed vireo, northern parula) are dependent on large forested acreage to successfully reproduce. Also, present are cuckoos, swifts, hummingbirds, nighthawks, woodpeckers, and the belted kingfisher.

Important game mammals occurring in the project area include white-tailed deer, eastern cottontail, swamp rabbit, gray squirrel, and fox squirrel. Commercially important furbearers include muskrat, nutria, river otter, raccoon, and mink. Other mammals expected include various species of insectivores, bats, rodents, and the nine-banded armadillo.

Numerous amphibians are expected to occur on stream and lake edges, ponds, and in forested wetlands of the study area including lesser siren, three-toed amphiuma, Gulf Coast toad, eastern narrow-mouthed toad, spring peeper, green treefrog, cricket frog, and bullfrog. Commercially important reptiles found in the streams, canals, and open water areas include American alligator, snapping turtle, alligator snapping turtle, smooth softshell turtle, spring softshell turtle, and diamondback terrapin. Other reptiles commonly found in the project area include red-eared turtle, painted turtle, Mississippi mud turtle, stinkpot, green anole, broad-headed skink, various water snakes, western ribbon snake, speckled kingsnake, and the western cottonmouth.

Threatened and Endangered Species

The Gulf sturgeon (Acipenser oxyrhynchus desotoi), federally listed as a threatened species, is an anadromous fish that occurs in many rivers, streams, and estuarine waters along the northern Gulf coast between the Mississippi River and the Suwannee River, Florida. In Louisiana, Gulf sturgeon have been reported at Rigolets Pass, rivers and lakes of the Lake Pontchartrain basin, and adjacent estuarine areas. Spawning occurs in coastal rivers between late winter and early spring (i.e., March to May). Adults and sub-adults may be found in those rivers and streams until November, and in estuarine or marine waters during the remainder of the year. Sturgeon less than two years old appear to remain in riverine habitats and estuarine areas throughout the year, rather than migrate to marine waters. Habitat alterations such as those caused by water control structures that limit and prevent spawning, poor water quality, and over-fishing have negatively affected this species.

On March 19, 2003, the Service and the National Marine Fisheries Service (NMFS) published a final rule in the Federal Register (Volume 68, No. 53) designating critical habitat for the Gulf sturgeon in Louisiana, Mississippi, Alabama, and Florida. Portions of the Pearl and Bogue Chitto Rivers, Lake Pontchartrain east of the Lake Pontchartrain Causeway, all of Little Lake, The Rigolets, Lake St. Catherine, and Lake Borgne within Louisiana were included in that designation. While sturgeon have been documented in study area waterways, those waterways are not designated critical habitat.

Federally listed as an endangered species, West Indian manatees (*Trichechus manatus*) occasionally enter Lakes Pontchartrain and Maurepas, and associated coastal waters and streams during the summer months (i.e., June through September). Manatee occurrences appear to be increasing, and they have been regularly reported in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, and in canals within the adjacent coastal marshes of Louisiana. They have also been occasionally observed elsewhere along the Louisiana Gulf coast. The manatee has declined in numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide may also adversely affect these animals. Should the proposed project involve activity in the aquatic environment in those areas during summer months, further consultation with this office will be necessary.

<u>Other Federal Trust Species</u>

The project-area forested wetlands may provide nesting habitat for the bald eagle (*Haliaeetus leucocephalus*), which was officially removed from the List of Endangered and Threatened Species on August 8, 2007. Bald eagles nest in Louisiana from October through mid-May. Eagles typically nest in mature trees (e.g., bald cypress, sycamore, willow, etc.) near fresh to intermediate marshes or open water in the southeastern Parishes. Areas with high numbers of nests include the Lake Verret Basin south to Houma, the marsh/ridge complex south of Houma to Bayou Vista, the north shore of Lake Pontchartrain, and the Lake Salvador area. Eagles also winter, and infrequently nest, in mature pine trees near large lakes in central and northern Louisiana. Major threats to this species include habitat alteration, human disturbance, and environmental contaminants (i.e., organochlorine pesticides and lead).

Breeding bald eagles occupy "territories" that they will typically defend against intrusion by other eagles, and that they likely return to each year. A territory may include one or more alternate nests that are built and maintained by the eagles, but which may not be used for nesting in a given year. Potential nest trees within a nesting territory may, therefore, provide important alternative bald eagle nest sites. Shoreline trees or snags located near large waterbodies provide the visibility and accessibility needed to locate aquatic prey. Bald eagles are vulnerable to disturbance during courtship, nest building, egg laying, incubation, and brooding. Disturbance during this critical period may lead to nest abandonment, cracked and chilled eggs, and exposure of small young to the elements. Human activity near a nest late in the nesting cycle may also cause flightless birds to jump from the nest tree, thus reducing their chance of survival.

Although the bald eagle has been removed from the List of Endangered and Threatened Species, it continues to be protected under the MBTA and the BGEPA. The Service developed the National Bald Eagle Management (NBEM) Guidelines to provide landowners, land managers, and others with information and recommendations to minimize potential project impacts to bald eagles, particularly where such impacts may constitute "disturbance," which is prohibited by the BGEPA. A copy of the NBEM Guidelines is available at:

<http://www.fws.gov/southeast/es/baldeagle/NationalBaldEagleManagementGuidelines.pdf>. Those guidelines recommend: (1) maintaining a specified distance between the activity and the nest (buffer area); (2) maintaining natural areas (preferably forested) between the activity and nest trees (landscape buffers); and (3) avoiding certain activities during the breeding season. On-site personnel should be informed of the possible presence of nesting bald eagles within the project boundary, and should identify, avoid, and immediately report any such nests to this office. If a bald eagle nest is discovered within or adjacent to the proposed project area, then an evaluation must be performed to determine whether the project is likely to disturb nesting bald eagles. That evaluation may be conducted on-line at: http://www.fws.gov/southeast/es/baldeagle. Following completion of the evaluation, that website will provide a determination of whether additional consultation is necessary. The Division of Migratory Birds for the Southeast Region of the Service (phone: 404/679-7051, e-mail: SEmigratorybirds@fws.gov) has the lead role in conducting such consultations. Should you need further assistance interpreting the guidelines or performing an on-line project evaluation, please contact this office.

The proposed study area is known to support colonial nesting waterbirds. Colonies may be present that are not currently listed in the database maintained by the Louisiana Department of Wildlife and Fisheries (LDWF). That database is updated primarily by monitoring the colony sites that were previously surveyed during the 1980s. Until a new, comprehensive coast-wide survey is conducted to determine the location of newly-established nesting colonies, we recommend that a qualified biologist inspect the proposed work site for the presence of undocumented nesting colonies during the nesting season. To minimize disturbance to colonies containing nesting wading birds (i.e., herons, egrets, night-herons, ibis, and roseate spoonbills), anhingas, and/or cormorants, all activity occurring within 1,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 1 through February 15, exact dates may vary within this window depending on species present). In addition, we recommend that on-site contract personnel be informed of the need to identify colonial nesting birds and their nests, and should avoid affecting them during the breeding season.

Management Areas

As you are aware, the Maurepas Swamp Wildlife Management Area (WMA) is located within the study area. Please contact the LDWF, Region 7 Office (225/765-2360), for further information regarding any additional permits that may be required to perform work on that WMA.

In addition, two federally approved wetland mitigation banks are located within the study area including the Sawgrass Bayou Mitigation Area owned by Blind River Properties (Mr. Dale Martin, 225/698-2700), and Lake Maurepas Mitigation Area owned by Stream Properties, LLC (Mr. Jeff Peterson, 337/433-1055, ext. 20). If the proposed project entails work within or adjacent to those bank sites, or if an alternative could potentially alter the hydrology of those sites, then the bank sponsors should be contacted.

POTENTIAL SIGNIFICANT IMPACTS

Depending on the alignment, construction of a flood protection levee has the potential to result in the direct loss and enclosure of valuable swamp and bottomland hardwood habitats. Developmental pressures on enclosed forested wetlands would likely increase with levee construction due to the reduced threat of flooding in the area. Reduced water exchange in the enclosed wetlands would lead to further water quality deterioration in the Lake Pontchartrain Basin by eliminating or reducing the filtering capacity of those wetlands. Wetland habitat losses would reduce populations of resident fish and wildlife, reduce important wintering habitat for waterfowl and other migratory birds, and reduce nursery habitat and detritus input important to the maintenance of estuarine-dependent fish and shellfish production.

PROBLEMS, OPPORTUNITIES, AND PLANNING OBJECTIVES

The most significant fish and wildlife related problem in the study area and throughout coastal Louisiana is the rapid loss of valuable wetland habitat. Between 1956 and 1978, baldcypress-tupelogum swamp within the Lake Pontchartrain Basin declined by 43,596 acres and total marsh declined by 79,232 acres (Bahr et al. 1983). During that same period, estuarine open water increased by more than 140,300 acres. This transition from vegetated wetlands to open water is believed to be associated with navigation and flood control projects, oil and gas exploration and extraction activities, shoreline erosion, subsidence, and saltwater intrusion. Between 1978 and 1988, over 23,000 acres of swamp between Lake Pontchartrain and Lake Maurepas were converted to marsh, due to the above factors. Land loss in those swamps in the next 20 years should reach approximately 1,200 acres. Approximately, 3,500 acres of marsh and nearly 6,300 acres of swamp are projected to be lost by the year 2045 (Louisiana Coastal Wetlands Conservation and Restoration Task Force 1993).

As a part of the 2004, Louisiana Coastal Area Ecosystem Restoration Study (LCA Plan) several near-term restoration projects have been identified for this hydrologic basin including the Blind River Diversion project and Hope Canal diversion project, which is also being evaluated under the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) program. The goals of those restoration projects along with the coastal flood protection goals of the proposed study are interrelated and necessitate an integrated solution. Those projects should be designed in collaboration with one another to ensure that a system-wide solution for coastal flood protection and restoration for the Lake Pontchartrain basin is achieved.

Deteriorating water quality in the Lake Pontchartrain Basin is at least partially correlated to the loss of that basin's wetlands; hence, a reduction in the waste assimilation capacity of the area is another problem adversely affecting fish and wildlife in the study area. According to Schurtz et al. (1984), factors adversely affecting water quality in Lake Pontchartrain are those related to urban development and urban pollution, altered land use patterns, and hydrologic modifications within the lake's watershed.

Water quality deterioration may be minimized by preserving remaining wetlands via limiting urban expansion and associated pollution discharges into wetlands. To that end, in order to discourage further wetland loss, the proposed hurricane protection levee should be at or as close to the wetland/non-wetland interface as possible. Should some wetlands be unavoidably enclosed within the levee, the integrity of present hydrologic regimes should be maintained via installation of water control structures in the levee to ensure adequate water circulation. Preservation of enclosed wetlands could be ensured via the purchase of non-development easements or local flood zoning ordinances. Furthermore, any pumping stations associated with the project should not discharge directly into canals or other open water bodies, but rather into wetland systems that can assimilate those nutrients being discharged.

The Corps is currently planning and implementing the construction of hurricane and flood protection projects to their newly-authorized protection levels for the Greater New Orleans area. It is currently estimated that approximately 75 million cubic yards of material would be needed to achieve the authorized level of protection for that project. The combined need for borrow necessary to complete authorized flood protection improvements and construction of proposed Federal and non-Federal hurricane and flood protection levees may exceed local availability. The searches for levee-building material has been conducted on a project-by-project basis, and has led to the least-expensive and easiest sources for borrow material, which are usually located within wetlands and/or bottomland hardwoods adjacent to the proposed levee. Use of such on-site sources often has adverse impacts on wetlands and is frequently inconsistent with coastal restoration efforts. Use of those sites will be counterproductive with respect to minimizing wetland impacts and attaining the goal of increasing non-structural hurricane protection within a sustainable ecosystem.

In order to address the above problems and opportunities, the Service recommends that the following planning objectives and constraints be included in any further planning of hurricane protection features for the study area:

1. Preserve and/or minimize impacts to wetlands and bottomland hardwoods in the study area.

2. The Service's priority selection process for borrow material outlined in our August 7, 2006, letter to the Corps regarding the Greater New Orleans Hurricane and Storm Damage Risk Reduction project (enclosed) should be utilized. In addition, the Service provided, via a September 9, 2008, letter, a map identifying potential borrow areas that are likely to have minimal impacts to fish and wildlife resources. Areas identified on that map should be investigated first as potential borrow sources.

3. Coordinate with the planning objectives and planning team of the LCA Plan near-term restoration projects identified for the Lake Pontchartrain Basin, particularly the Hope Canal Diversion project.

4. Avoid impacts to threatened and endangered species and their habitat.

FISH AND WILDLIFE CONSERVATION MEASURES

Implementation of the proposed levee could potentially have significant direct impacts on fish and wildlife resources. Of equal concern is the potential for loss, via future development, of fish and wildlife habitat enclosed by the levee. The Service believes that project plans can be designed to mitigate those negative impacts.

The President's Council on Environmental Quality defined the term "mitigation" in the National Environmental Policy Act regulations to include: (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and (e) compensating for the impact by replacing or providing substitute resources or environments.

The Service's Mitigation Policy (Federal Register Volume 46, No. 15, January 23, 1981) supports and adopts this definition of mitigation and considers its specific elements to represent the desirable sequence of steps in the mitigation planning process. That policy identifies four resource categories that are used to insure that the level of mitigation recommended by Service biologists will be consistent with the fish and wildlife resource values involved.

Considering the high value for fish and wildlife and the relative scarcity of the forested wetlands potentially impacted by the proposed levee, those wetlands have been designated Resource Category 2 habitats. The mitigation goal for habitats in this resource category is no net loss of in-kind habitat value. This goal could best be achieved via loss avoidance; in this case, realigning the levee such that forested wetlands lost to levee construction would be minimized and forested wetlands would not be enclosed within the levee.

If the enclosure of wetlands within the proposed levee is necessary to provide for floodwater storage, mechanisms for protecting enclosed wetlands and for compensating habitat value losses associated with levee construction would have to be developed. Preservation of enclosed wetlands might be accomplished by installing water control structures in the levee that could be properly operated to ensure adequate water exchange. Further, protection of the enclosed wetlands from future development (thus preserving floodwater storage areas) could be ensured via purchase of non-development easements. Compensation for wetland habitat value losses associated with levee construction would likely involve acquisition and management of another similar wetland area. Detailed mitigation needs will be determined in the feasibility stage.

1. Mitigate impacts to wetlands and bottomland hardwoods by:

    A. Incorporating hurricane protection features (e.g., floodwalls, etc.) that would minimize impacts to fish and wildlife habitat;

    B. Requiring that hurricane protection levees follow, as closely as possible, the wetland/non-wetland interface and limiting hurricane protection to existing urban developments;

C. Requiring that borrow needed for levee construction be taken from non-forested, non-wetland areas [the Service's priority selection process for borrow material should be utilized, and areas identified on the Service's potential borrow map should be investigated (enclosures)];

D. Installing an adequate number of water-control structures in hurricane protection levees that enclose wetlands to maintain normal water exchange and preclude drainage (such structures should be closed only in advance of tropical storms);

E. Acquiring non-development easements on enclosed wetlands to ensure their continued use as floodwater storage areas and to preclude any secondary development;

F. Incorporating water quality improvements by routing urban runoff through enclosed wetlands and discharging any pumped water into floodside wetlands;

F. Ensuring adequate internal drainage exists within the leveed area to prevent levees from compounding existing flooding problems, thus leading to future flood control projects with a resulting loss of wetlands and fish and wildlife resources; and,

G. Implementing measures to compensate for unavoidable losses of wetland habitat values.

2. Avoid impacts to endangered or threatened species and their habitats.

3. Avoid impacts to active wading bird rookeries. Avoid construction activities within 1,500 feet of any active wading bird rookery during the nesting season.

UPCOMING FISH AND WILDLIFE ACTIVITIES

The following data will be needed to enable the Service to conduct a detailed analysis of project impacts on fish and wildlife resources and to formulate measures to mitigate any losses to those resources.

1. Identification of any new alternatives to be considered, including detailed project plans (e.g., a written description and map) for those alternatives.

2. An estimate of current, future-with and future-without-project development rates within the project area(s), presented in 10-year intervals, to be impacted by alternatives being considered.

3. Identification of habitats, by type and acreage, to be impacted by various

alternatives being considered. That data should also be presented in 10-year intervals.

We look forward to assisting the Corps in the documentation of existing conditions, development of alternatives, and assessment of effects of project alternatives on Federal trust resources during the subsequent feasibility study. Should you have any questions regarding our comments, please contact Angela Trahan (337/291-3137) of this office.

Sincerely,

James F. Boggs
Supervisor
Louisiana Field Office

Enclosures

cc: DOI, OEPC, Washington, D.C. (Attn.: Loretta Sutton)
DOI, OEPC, Albuquerque, NM (Attn.: Steven Spencer)
FWS, BAP & HC (ERT), Arlington, VA (Attn.: Stefanie Stavrakas)
FWS, Atlanta, GA (Attn.: Richard Warner)
EPA, Dallas, TX
NMFS, Baton Rouge, LA
LDWF, Region 7 Office, Baton Rouge, LA
LDWF, Baton Rouge, LA (Attn.: Heather Finley)
LDWF, Natural Heritage Program, Baton Rouge, LA

LITERATURE CITED

Bahr, L.M., Jr. R. Costanza, J.W. Day, S.E. Bayley, C. Neill, S.G. Leibowitz, and J. Fruci. 1983. Ecological characterization of the Mississippi Deltaic Plain Region: a narrative with management recommendations. U.S. Fish and Wildlife Service, Division of Biological Services, Washington, D.C. FWS/OBS-82/69. 189 pp.

Louisiana Coastal Wetlands Conservation and Restoration Task Force. 1993. Draft Louisiana Coastal Wetlands Restoration Plan, Pontchartrain Basin, Appendix A. 94 pp.

Schurtz, M.H., K.M. St. Pe. 1984. Report on Interim Findings: Water Quality Investigation of Environmental Conditions in Lake Pontchartrain. Louisiana Department of Environmental Quality, Water Pollution Control Division. 85 pp.

Wilson, B.C., C.A. Manlove, and C.G. Esslinger. 2002. North American Waterfowl Management Plan, Gulf Coast Joint Venture: Mississippi River Coastal Wetlands Initiative. North American Waterfowl Management Plan, Albuquerque, NM. 28 pp. + appendix.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

October 9, 2012

Colonel Edward R. Fleming
District Commander
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Fleming:

The Fish and Wildlife Service (Service) is submitting this Planning-aid Letter (PAL) based upon recent information provided by the U.S. Army Corps of Engineers' (Corps) Project Delivery Team (PDT) for the West Shore, Lake Pontchartrain, Louisiana, Hurricane and Storm Damage Risk Reduction Feasibility Study (WSLP) in Ascension, St. Charles, St. James, and St. John the Baptist Parishes, Louisiana. The Service is aware that the Corps plans to choose a Tentatively Selected Plan (TSP) by the end of 2012, and we submit the following recommendations for consideration in that project development decision in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). This PAL does not constitute the report of the Secretary of the Interior as required by Section 2(b) of the Fish and Wildlife Coordination Act.

The Corps is conducting a study to determine the feasibility of providing Federal hurricane protection to the western shore of Lake Pontchartrain. The study area is bounded by the Bonnet Carré Spillway to the east, the Mississippi River to the south, Lakes Pontchartrain and Maurepas to the north, and St. James Parish/Ascension Parish line to the west. The communities in this area include Laplace, Reserve, Gramercy, Lutcher, Garyville, Riverland Heights, and Carrollwood. The Louisiana Department of Wildlife and Fisheries manages the Maurepas Wildlife Management Area (WMA), which consists of a majority of the swampland within the project area.

According to an August 2012 map provided by the PDT, there are three preliminary levee alignments which have been identified through previous reconnaissance and feasibility studies that are being considered for the TSP (Figure 1). Generally, those alignments extend from the west guide levee of the Bonnet Carré Spillway to the vicinity of Hope Canal north of Garyville in St. John the Baptist Parish. Alignment A generally follows the wetland/non-wetland interface from LaPlace to Hope Canal. Alignment C generally follows en existing pipeline corridor north of Alignment A. Alignments A and C both tie into the Mississippi River levee. Alignment D generally follows the Interstate Highway 10 (I-10) corridor and extends outside the original project study area into Ascension Parish to tie into an existing non-federal levee.

For descriptions of fish and wildlife resource conditions, threatened and endangered species, other species of management concern, and existing management areas within the project study area, please reference the Service's January 9, 2009, letter (enclosed) in response to the Corps' Notice of Intent to prepare a Draft Environmental Impact Statement. Those descriptions and concerns have not changed since our 2009 letter. Please note that the Service will provide guidelines for in-water work in areas that potentially support the endangered West Indian manatee (*Trichechus manatus*) to avoid and minimize impacts to that species during project construction. Also, on September 11, 2009, the Service published two federal regulations establishing the authority to issue permits for non-purposeful bald eagle take (typically disturbance) and eagle nest take when recommendations of the National Bald Eagle Management Guidelines (http://www.fws.gov/southeast/es/baldeagle/NationalBaldEagleManagementGuidelines.pdf) cannot be achieved. Should you need further assistance interpreting the guidelines, avoidance measures, or performing an on-line project evaluation to determine whether application for a permit is necessary, please contact this office.

Depending on the alignment, construction of a flood protection levee has the potential to result in the direct loss and enclosure of valuable swamp and bottomland hardwood habitats. Developmental pressures on enclosed forested wetlands would likely increase with levee construction due to the reduced threat of flooding in the area. Reduced water exchange in the enclosed wetlands would lead to further water quality deterioration in the Lake Pontchartrain Basin by eliminating or reducing the filtering capacity of those wetlands. Wetland habitat losses would reduce populations of resident fish and wildlife, reduce important wintering habitat for waterfowl and other migratory birds, and reduce nursery habitat and detritus input important to the maintenance of estuarine-dependent fish and shellfish production.

The Service recommends implementation of Alignment A because it discourages wetland loss by enclosing the least amount of wetlands, involves the least amount of direct wetland impacts due to construction, and has the least impact to the Maurepas WMA (Table 1). If implementation of Alignment A is determined to be infeasible, then the Service would support Alignment C because it is the next least-damaging alternative to Alignment A (Table 1). The Service discourages selection of Alignment D because of the amount and quality of forested wetlands that would be enclosed, the amount of direct impacts to high quality forested wetlands that would be affected during construction, the alteration of the present hydrologic regime over a much larger area of high quality fish and wildlife habitat, the enclosure of the southern portion of the Maurepas WMA (Table 1, Figure 2), and the impacts to two proposed coastal restoration projects (i.e., the Convent to Blind River Diversion and the Hope Canal Freshwater Reintroduction).

The Service is aware that Alignments A and C do not provide protection to the entrance and exit ramps to I-10 at its intersections with United States Highway 61 (Hwy 61) and Louisiana State Highway 641 (Hwy 641), which undergo flooding during excessive rainfall events as well as during major storm events. Those alignments would also not provide flood protection to structures within St. James Parish, which are included within the study area and for which that Parish would like flood protection. In order to provide maximum consideration to the conservation of fish and wildlife habitats, as well as to address the goals of the proposed study, the Service recommends that the Corps consider installing localized ring levees at I-10 and its intersections with Hwy 61 and Hwy 641 to eliminate flooding and to maintain evacuation and emergency vehicle routes between

Baton Rouge and New Orleans. We also recommend extending Alignment C along either: (1a) the wetland/non-wetland interface up to Louisiana State Highway 3125 (Hwy 3125) west of Grand Point; or (1b) Hwy 61 to its intersection with I-10. The Service proposes Alignments C-1a and C-1b (Table 1, Figure 2), along with the localized ring levees, as possible alternatives to Alignment D. Those additional alternatives would allow for reducing and minimizing impacts to fish and wildlife resources while providing flood protection for structures within St. James Parish as well as the major highway intersections that allow ingress and egress to the affected areas and maintain evacuation and emergency routes between Baton Rouge and New Orleans. The Service is willing to work with the Corps on a finalized alternative alignment.

Table 1. Proposed alignments and the Service's recommended alignment revisions for consideration as alternatives to Alignment D.

ALIGNMENT	LENGTH*	ENCLOSED WETLANDS*	IMPACTS, ISSUES, and PROTECTION
Alignment A	19 miles	5 square miles	• Least damaging alternative • Encloses minimal amount of wetlands • Least impacts to Maurepas WMA • No impacts to Convent/Blind River Diversion • Impacts to Hope Canal Diversion need to be addressed • Provides protection for Montz, Laplace, Reserve, Garyville
Alignment C	19 miles	16 square miles	• Second least damaging alternative • Encloses additional wetlands • Small impacts to Maurepas WMA • No impacts to Convent/Blind River Diversion • Impacts to Hope Canal Diversion need to be addressed • Provides protection for Montz, Laplace, Reserve, Garyville
Alignment C-1a	29 miles	20.5 square miles	• Encloses additional wetlands • Few impacts to Maurepas WMA • No impacts to Convent/Blind River Diversion • Impacts to Hope Canal Diversion need to be addressed • Provides protection for Montz, Laplace, Reserve, Garyville, Gramercy, Lutcher, Grand Point
Alignment C-1b	28 miles	61 square miles	• Encloses extensive wetland areas • Impacts the southwestern portion of Maurepas WMA • Impacts to Hope Canal Diversion need to be addressed • Impacts to Convent/Blind River Diversion need to be addressed • Provides protection for Montz, Laplace, Reserve, Garyville, Gramercy, Lutcher, Grand Point, Convent, Romeville
Alignment D	27 miles	79 square miles	• Encloses greatest amount of wetlands • Impacts southern portion of Maurepas WMA • Impacts to Hope Canal Diversion need to be addressed • Impacts to Convent/Blind River Diversion need to be addressed • Provides protection for Montz, Laplace, Reserve, Garyville, Gramercy, Lutcher, Grand Point, Convent, Romeville

* Unrefined estimates using ArcMap® and Corps' estimates from their Feasibility Scoping Meeting information.

Regardless of which alignment the Corps chooses as the TSP, the Service recommends that (1) the integrity of present hydrologic regimes be maintained via installation of water control structures in the levee to ensure adequate water circulation, and (2) preservation of enclosed wetlands be ensured in perpetuity via the purchase of non-development easements and/or local flood zoning ordinances. Providing perpetual preservation of enclosed wetlands would also provide for flood storage areas within the levee system during excessive rainfall events. The Service also recommends that any pumping stations associated with the project should not discharge directly into canals or other open water bodies, but rather into wetland systems that can assimilate those nutrients being discharged.

The Corps has almost completed full implementation of the newly-authorized protection levels for hurricane and flood protection projects in the Greater New Orleans area. The combined need for borrow necessary to complete authorized flood protection improvements and construction of other proposed and implemented Federal and non-Federal hurricane and flood protection levees may have diminished local availability. The searches for levee-building material have been conducted on a project-by-project basis, and have led to the least-expensive and easiest sources for borrow material, which are usually located within wetlands and/or bottomland hardwoods adjacent to the proposed levee. Use of such on-site sources often has adverse impacts on wetlands and is frequently inconsistent with coastal restoration efforts. Use of those sites will be counterproductive with respect to minimizing wetland impacts and attaining the goal of increasing non-structural hurricane protection within a sustainable ecosystem. The Service's priority selection process for borrow material outlined in our August 7, 2006, letter to the Corps regarding the Greater New Orleans Hurricane and Storm Damage Risk Reduction project (enclosed) should be utilized. In addition, the Service provided, via a September 9, 2008, letter, a map (enclosed) identifying potential borrow areas that are likely to have minimal impacts to fish and wildlife resources. Areas identified on that map should be investigated first as potential borrow sources. The Service will provide an updated map that is more specific to the subject study area.

We appreciate the Corps' consideration of our recommendations for further development of a TSP for the proposed project. Should you or your staff have any questions, or if you would like to meet with us regarding the content of this letter, please contact Ms. Brigette Firmin (337/291-3108) of this office.

Sincerely,

Jeffrey D. Weller
Supervisor
Louisiana Ecological Services Office

Enclosures

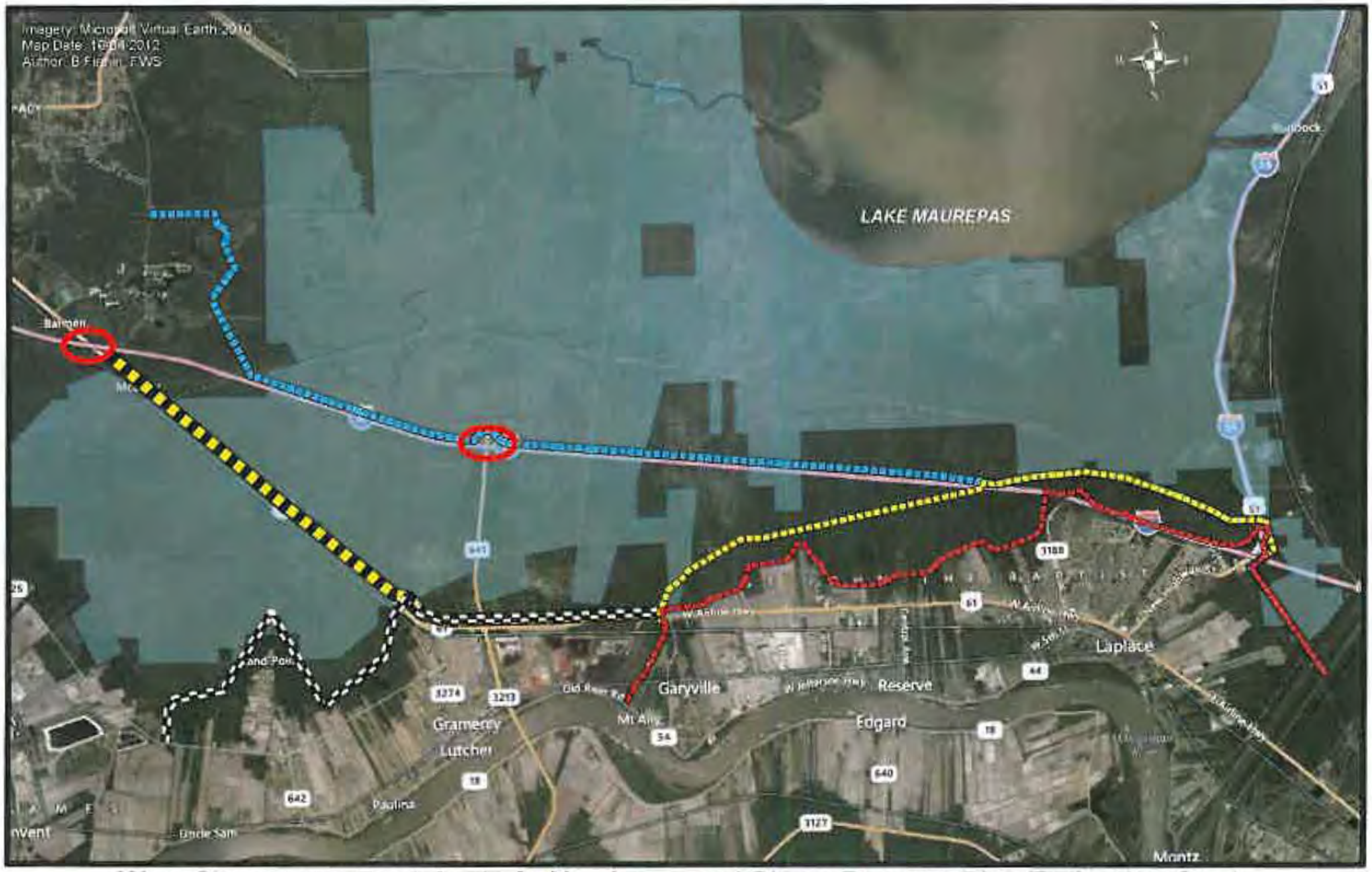
cc: EPA, Dallas, TX
LDWF, Baton Rouge, LA
CPRA, Baton Rouge, LA
LDNR, Coastal Management Division, Baton Rouge, LA

Figure 1. Currently proposed alignments for the West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Study.

West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Study

Alignment_A   Alignment_C   Alignment_D

Figure 2. Proposed revised alignments for the West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Study.



West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Study

Alignment_A
Hwy_intersection_ring_levees
Alignment_C
Alignment_C_1a
Alignment_C_1b
Alignment_D
La_State_Wildlife_Managed_Areas

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

August 7, 2006

Colonel Richard P. Wagenaar
District Commander
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Wagenaar:

As you know, the U.S. Fish and Wildlife Service (Service) is assisting the U.S. Army Corps of Engineers (Corps) in assessing impacts of, and mitigation requirements for, borrow sites which are needed to complete authorized improvements, and to construct Federal and non-Federal hurricane/flood protection levees in southern Louisiana. Those improvements to hurricane and flood control projects are authorized by the Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico (Public Laws 109-148, PL 84-99 and PL 109 234 (4^{th} supplemental)). This letter is provided in accordance with the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.), Fish and Wildlife Coordination Act (FWCA, 48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and the Migratory Bird Treaty Act (40 Stat. 755, as amended; 16 U.S.C. 703 et seq.), but it does not constitute the final report of the Secretary of the Interior as required by Section 2(b) of the Fish and Wildlife Coordination Act.

Through the efforts of Task Force Guardian, the Corps has restored Hurricane Katrina-damaged hurricane/flood protection projects to their authorized or previously permitted/constructed protection levels. Identification of borrow areas needed to complete those repairs utilized a protocol that prioritized selection of those sites in the following order: existing commercial pits, upland sources, previously disturbed/manipulated wetlands within a levee system, and low-quality wetlands outside a levee system. The Service supports the use of such protocols to avoid and minimize impacts to wetlands and bottomland hardwoods within project areas. Avoidance and minimization of those impacts helps to provide consistency with restoration strategies and compliments the authorized hurricane protection efforts. Such consistency is also required by Section 303(d)(1) of the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA).

Accordingly, the Service recommends that prior to utilizing borrow sites every effort should be made to reduce impacts by using sheetpile and/or floodwalls to increase levee heights wherever feasible. In addition, the Service recommends that the following protocol be adopted and utilized to identify borrow sources in descending order of priority:

1. Permitted commercial sources, authorized borrow sources for which environmental clearance and mitigation have been completed, or non-functional levees after newly constructed adjacent levees are providing equal protection.

2. Areas under forced drainage that are protected from flooding by levees, and that are:

   a) non-forested (e.g., pastures, fallow fields, abandoned orchards, former urban areas) and non-wetlands;

   b) wetland forests dominated by exotic tree species (i.e., Chinese tallow-trees) or non-forested wetlands(e.g., wet pastures), excluding marshes;

   c) disturbed wetlands (e.g., hydrologically altered, artificially impounded).

3. Sites that are outside a forced drainage system and levees, and that are:

   a) non-forested (e.g., pastures fallow fields, abandoned orchards, former urban areas) and non-wetlands;

   b) wetland forests dominated by exotic tree species (i.e., Chinese tallow-trees) or non-forested wetlands(e.g., wet pastures), excluding marshes;

   c) disturbed wetlands (e.g., hydrologically altered, artificially impounded).

Notwithstanding this protocol, the location, size and configuration of borrow sites within the landscape is also critically important. Coastal ridges, natural levee flanks and other geographic features that provide forested/wetland habitats and/or potential barriers to hurricane surges should not be utilized as borrow sources, especially where such uses would diminish the natural functions and values of those landscape features.

To assist in expediting the identification of borrow sites, the Service recommends that immediately after the initial identification of a new borrow site the Corps should initiate informal consultation with the Service regarding potential impacts to federally listed threatened or endangered species. To aid you in complying with those proactive consultation responsibilities, the Service has enclosed a list of threatened and endangered species and their critical habitats within the coastal parishes of the New Orleans District.

The Service offers the following additional recommendations for reducing borrow site impacts on fish and wildlife resources and, where feasible, enhancing those resources. However, these additional recommendations should not be implemented if they would result in the expansion of existing borrow pits or construction of new borrow pits in wetlands or bottomland hardwoods.

1. A minimum of 30 percent of the borrow pits' edge should slope no greater than 5 horizontal (H):1 vertical (V), starting from the water line down to a depth of approximately 5 feet.

2. Most of the woody vegetation removed during clearing and grubbing should be placed into the deepest parts of the borrow pits and the remaining debris should be placed in the water along the borrow pit shorelines, excluding those areas where the 5H:1V slope, per recommendation 1, have been constructed.

3. Following construction, perimeter levees (if constructed) around each borrow pit should be gapped at 25-foot intervals with an 8-foot-wide breach, the bottom elevation of which should be level with the adjacent natural ground elevation.

When avoidance and minimization of bottomland hardwood and wetland impacts is not practicable, all unavoidable net losses of those habitats should be fully offset via compensatory mitigation. Such compensatory mitigation should sited within the watershed and/or hydrologic unit where the impact occurred, and should be completed concurrently with borrow operations, or as soon thereafter as possible.

The combined need for borrow necessary to complete authorized improvements to and construction of Federal and non-Federal hurricane/flood protection levees, and the potential construction of levees capable of withstanding a category 5 hurricane, will require substantial amounts of borrow. It is highly likely such amounts would exceed local availability. In the case of ongoing hurricane/flood protection projects (e.g., Morganza to the Gulf) the search for levee-building material has been conducted primarily on project-by-project basis. In the context of such project-by-project searches for borrow material, the least-expensive and easiest sources of borrow material are usually located within wetlands and/or bottomland hardwoods, adjacent to the proposed levee. Such on-site sources, however, often involve adverse impacts to wetlands, thus exacerbating the overall wetland loss problem in all coastal basins, especially those in the deltaic plain of southeast Louisiana. In short, while such on-site sources are relatively inexpensive, they will frequently be inconsistent with coastal restoration efforts and, to the extent that wetlands will be adversely impacted, use of those sites will be counterproductive with respect to minimizing wetland impacts and attaining the goal of increasing non-structural hurricane protection within a sustainable ecosystem.

Large-scale, off-site borrow sources could have the potential to reduce environmental impacts from levees and expedite project-by-project environmental review. Such potential "programmatic" borrow sources could include uplands along the Mississippi River, beneficial use of sediments dredged for navigation purposes (including the mining of disposal sites), the Mississippi River, and offshore deposits (e.g., Ship Shoal). As part of the planning process, we recommend that the Corps begin investigating the practicability of various large-scale, off-site borrow sources and actively involve all resource agencies with the Protection and Restoration Office's Borrow Team efforts.

Programmatic planning would be essential to identify borrow sites of acceptable quantity and quality, while avoiding and/or minimizing adverse environmental impacts. We therefore recommend that a plan be developed that integrates borrow resources, uses, and needs for various programs and activities. Guiding principles should be developed to identify borrow resources, borrow-site designs, and prioritize uses to avoid competing for resources, maximize benefits with those resources, and avoid adverse environmental impacts.

We appreciate the opportunity to provide this planning-aid letter and would be pleased to assist your agency in further identification of potential borrow sources. Should you or your staff have any questions regarding this letter, please contact David Walther (337/291-3122) of this office.

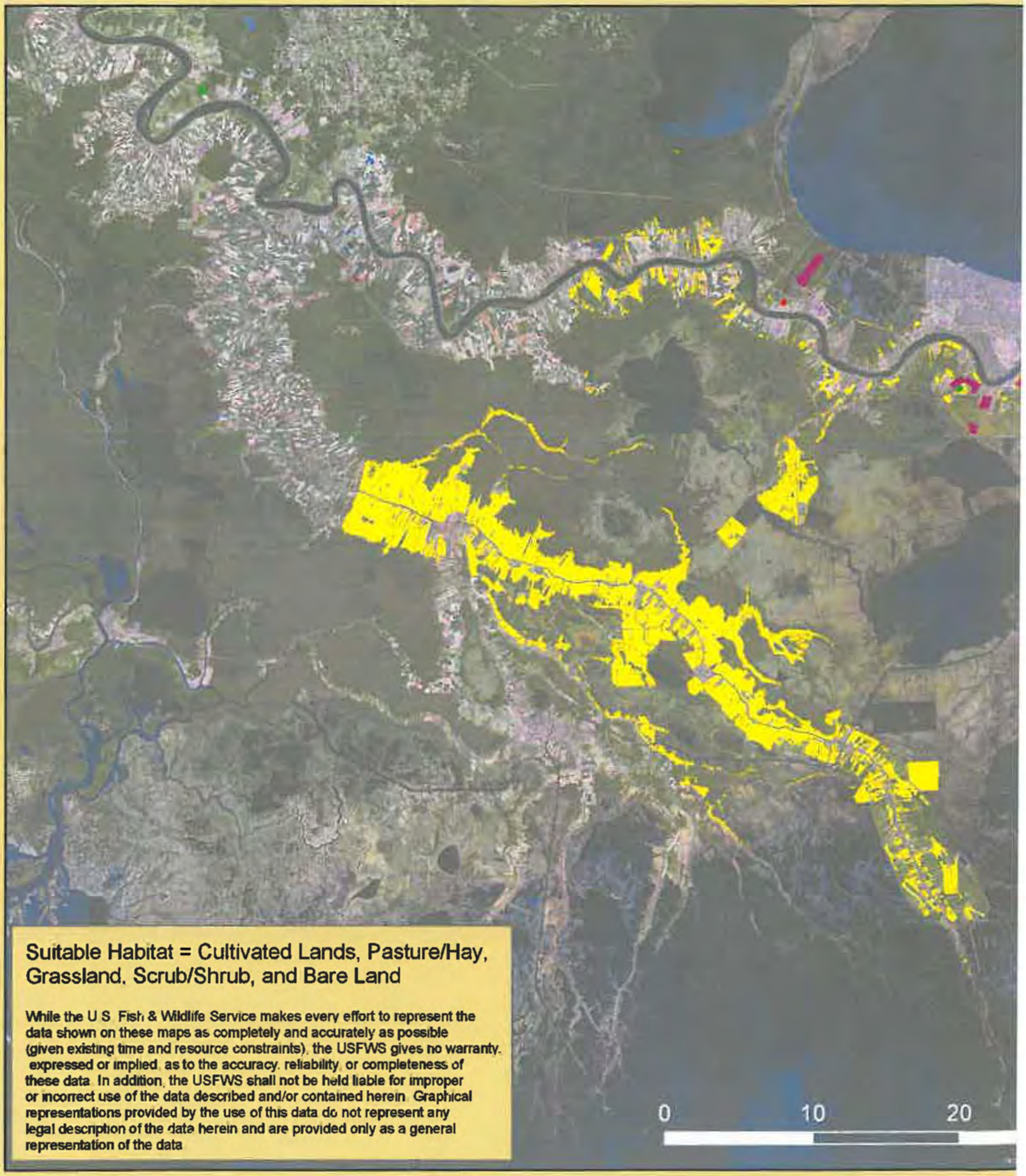
Sincerely,

Russell C. Watson
Supervisor
Louisiana Field Office

Enclosure

cc: National Marine Fisheries Service, Baton Rouge, LA
EPA, Dallas, TX
LA Dept. of Wildlife and Fisheries, Baton Rouge, LA
LA Dept. of Natural Resources, CMD, Baton Rouge, LA
LA Dept. of Natural Resources, CRD, Baton Rouge, LA

U.S. Fish & Wildlife Service



Suitable Habitat = Cultivated Lands, Pasture/Hay, Grassland, Scrub/Shrub, and Bare Land

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A
Annex I

Technical, Institutional and Public Significance of Relevant Resources

Table I-1: Significance of relevant resources located within the project area.

Resource	Institutionally Significant	Technically Significant	Publicly Significant
Soils, Water bottoms, Prime and Unique Farmlands	Council on Environmental Quality (CEQ) memorandum dated August 11, 1980, entitled "Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act (NEPA)"; Executive Order 11990 - Protection of Wetlands; Agriculture and Food Act of 1981 (Public Law 97-98) containing the Farmland Protection Policy Act (PL 97-98; 7 U.S.C. 4201 *et seq*.).	Technically significant in determining soils engineering and environmental suitability, based on their physical and chemical properties, for proposed activities. Water bottoms are technically significant because the estuarine bottom sediment characteristics (water bottoms) benthic organismal distribution and is an integral component of the benthic boundary layer.	Significant to the public for determining suitability of construction capabilities, agriculture suitability, and suitability for septic tank type disposal of sanitary waste.
Hydrology	NEPA of 1969; Clean Water Act of 1972; Storm damage Control Act of 1944; Coastal Barrier Resources Act of 1982; Rivers and Harbors Act of 1899; River and Harbor and Storm damage Control Act of 1970; Watershed Protection and Storm damage Prevention Act of 1954; Submerged Lands Act of 1953; Coastal Zone Management Act of 1972; Safe Drinking Water Act of 1974; Estuary Protection Act of 1968; Resource Conservation and Recovery Act of 1976; Comprehensive Environmental Response, Compensation and Liability Act of 1980; Executive Order 11988 Floodplain Management.	Civil Works water resources development projects typically impact (positively or negatively) the interrelationships and interactions between water and its environment.	Publicly significant because the public demands clean water, hazard-free navigation, and protection of estuaries and floodplain management.
Water Quality	Clean Water Act of 1972; Pollution Prevention Act of 1990, the Safe Drinking Water Act of 1974; Water Resources Planning Act of 1965.	Technically significant to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.	Publicly significant because of the desire for clean water and water-related activities such as boating, swimming, fishing, and as a source of potable water.
Vegetation Resources	Coastal Barrier Resources Act of 1982; Coastal Zone Management Act of 1972; Emergency Wetlands Resources Act of 1986; Estuary Protection Act of 1968; Fish and Wildlife Conservation Act of 1980; Fish and Wildlife Coordination Act of 1958; NEPA of 1969; North American Wetlands Conservation Act of 1989; the Water Resources Development Acts of 1976, 1986, 1990, and 1992; Executive Order 13186 - Migratory Bird Habitat Protection.	Technically significant because they are a critical element of the barrier shoreline habitats. Vegetation resources serve as the basis of productivity, contribute to ecosystem diversity, provide various habitat types for fish and wildlife, and are an indicator of the health of coastal habitats.	Publicly significant because of the high priority that the public places on their aesthetic, recreational, and commercial value.
Wildlife Resources	NEPA of 1969; Coastal Zone Management Act of 1972; Estuary Protection Act of 1968; Fish and Wildlife Coordination Act of 1958; Migratory Bird Conservation Act of 1929; Migratory Bird Treaty Act of 1918; Endangered Species Act of 1973; Fish and Wildlife Conservation Act of 1980; North American Wetlands Conservation Act of 1989; Executive Order 13186 - Migratory Bird Habitat Protection; Marine Mammal Protection Act of 1972.	Technically significant because they are a critical element of the barrier shoreline ecosystem, they are an indicator of the health of various coastal habitats, and many wildlife species are important recreation and commercial resources.	Publicly significant because of the high priority that the public places on their aesthetic, recreational, and commercial value.

Table I-1: Significance of relevant resources located within the project area.

Resource	Institutionally Significant	Technically Significant	Publicly Significant
Aquatic Resources	National Environmental Policy Act of 1969; Coastal Zone Management Act of 1972; Estuary Protection Act of 1968.	Technically significant because plankton provide a major, direct food source for animals in the water column and in the sediments; are responsible for at least 40 percent of the photosynthesis occurring on the earth; important for their role in nutrient cycling; plankton productivity is a major source of primary food-energy for most estuarine systems throughout the world; and phytoplankton production is the major source of autochthonous organic matter in most estuarine ecosystems (Day et al. 1989).	Publicly significant because plankton constitute the lowest trophic food level for many larger organisms important to commercial and recreational fishing. There is also public health concern with noxious plankton blooms (red and brown tides) that produce toxins, and large-scale blooms can lead to hypoxic conditions, which can result in fish kills.
Fisheries	Fish and Wildlife Coordination Act of 1958; Endangered Species Act of 1973; Magnuson-Stevens Fishery Conservation and Management Act of 1976; Coastal Zone Management Act of 1972; Estuary Protection Act of 1968.	Technically significant because they are a critical element of many valuable freshwater and marine habitats, they are an indicator of the health of various freshwater and marine habitats, and many fish species are important commercial resources.	Publicly significant because of the high priority that the public places on their esthetic, recreational, and commercial value. Fisheries resources in the project area include marine and estuarine finfish and shellfish.
Essential Fish Habitat	Magnuson-Stevens Fishery Conservation and Management Act of 1976.	Technically significant because it includes those waters and substrate necessary to Federally-managed fish species for spawning, breeding, feeding or growth to maturity.	Publicly significant because of the high value that the public places on seafood and the recreational and commercial opportunities it provides.
Threatened and Endangered Species	Endangered Species Act of 1973; Marine Mammal Protection Act of 1972; Bald Eagle Protection Act of 1940.	Technically significant because the status of such species provides an indication of the overall health of an ecosystem.	Publicly significant because of the desire of the public to protect them and their habitats.
Cultural and Historic Resources	National Historic Preservation Act of 1966; Abandoned Shipwreck Act of 1987; Archeological Resources Protection Act of 1979; National Environmental Policy Act of 1969.	Technically important because of their association or linkage to past events, to historically important persons, and to design and/or construction values; and for their ability to yield important information about prehistory and history.	Publicly important because preservation groups and private individuals support their protection, restoration, enhancement, or recovery.
Recreational Resources	Federal Water Project Recreation Act of 1965; Land and Water Conservation Fund Act of 1965.	Technically significant because of the high economic value of recreational activities and their contribution to local, state, and national economies.	Publicly significant because of the high value that the public places on fishing, hunting, and boating, as measured by the large number of fishing and hunting licenses sold in Louisiana, and the large per-capita number of recreational boat registrations in Louisiana.
Air Quality	Clean Air Act of 1963, as amended, and the Louisiana Environmental Quality Act of 1983, as amended.	Air quality is technically significant because of the status of regional ambient air quality in relation to the National Ambient Air Quality Standards (NAAQS).	Air quality is publicly significant because of the desire for clean air and public health concerns expressed by many citizens.
Socioeconomic and Human Resources	National Environmental Policy Act of 1969; Estuary Protection Act of 1968; Clean Water Act of 1972; Rivers and Harbors Act of 1899; Watershed Protection and Storm damage Protection Act of 1954. Executive Order 12898 of 1994 – Environmental Justice.	Technically significant because the social and economic welfare of the Nation may be positively or adversely impacted by the proposed action; the social and economic welfare of minority and low-income populations may be positively or disproportionately impacted by proposed actions.	Publicly significant because of the public's concern for health, welfare, and economic and social well-being from water resources projects; also public concerns about the fair and equitable treatment of all people

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A
Annex J

Environmental Compliance Laws

Table J-1: Relevant Environmental Federal Statutory Authorities and Executive Orders.
(Note: this list is not complete or exhaustive.)

Abandoned Shipwreck Act of 1987
American Indian Religious Freedom Act of 1978
Anadromous Fish conservation Act of 1965
Antiquities Act of 1906
Archeological Resources Protection Act of 1979
Archeological and Historical Preservation Act of 1974
Bald Eagle Protection Act of 1940
Clean Air Act of 1970
Clean Water Act of 1977
Coastal Barrier Improvement Act of 1990
Coastal Barrier Resources Act of 1982
Coastal Wetlands Planning, Protection, and Restoration Act of 1990
Coastal Zone Management Act of 1972
Comprehensive Environmental Response, Compensation, and Liability Act of 1980
Consultation and Coordination with Indian Tribal Governments (EO 13175) of 2000
Emergency Planning and Community Right-to-Know Act of 1986
Emergency Wetlands Restoration Act of 1986
Endangered Species Act of 1973
Environmental Quality Improvement Act of 1970
Estuaries and Clean Water Act of 2000
Estuary Protection Act of 1968
Estuary Restoration Act of 2000
Exotic Organisms (EO 11987) of 1977
Farmland Protection Policy Act of 1981
Federal Actions to Address Environmental Justice in Minority Populations & Low-Income Populations (EO 12898) of 1994
Federal Emergency Management (EO 12148) of 1979
Federal Facilities Compliance Act of 1992
Federal Land Policy and Management Act of 1976
Federal Water Pollution Control Act of 1972
Federal Water Project Recreation Act of 1965
Fish and Wildlife Conservation Act of 1980
Fish and Wildlife Coordination Act of 1934
Flood Control Act of 1944
Floodplain Management (EO 11988) of 1977
Food Security Act of 1985
Greening of the Government Through Efficient Energy Management (EO 13148) of 2000
Historic Sites Act of 1935
Historical and Archeological Data-Preservation Act of 1974
Indian Sacred Sites (EO 13007) of 1996
Invasive Species (EO 13112) of 1999
Land & Water Conservation Fund Act of 1965
Magnuson-Stevens Fishery Conservation and Management Act of 1976
Marine Mammal Protection Act of 1972
Marine Protected Areas (EO 13158) of 2000
Marine Protection, Research, and Sanctuaries Act of 1972
Migratory Bird Conservation Act of 1929
Migratory Bird Treaty Act of 1918
Migratory Bird Habitat Protection (EO 13186) of 2001
National Environmental Policy Act of 1969
National Historic Preservation Act of 1966
Native American Graves Protection and Repatriation Act of 1990
Neotropical Migratory Bird Conservation Act of 2000
Noise Control Act of 1972
Nonindigenous Aquatic Nuisance Prevention and Control Act of 1996
North American Wetlands Conservation Act of 1989
Oil Pollution Act of 1990
Outer Continental Shelf Lands Act of 1953
Pollution Prevention Act of 1990
Prime and Unique Farmlands, 1980 CEQ Memorandum
Protection and Enhancement of the Cultural Environment (EO 11593) of 1971
Protection and Enhancement of Environmental Quality (EO 11991) of 1977
Protection of Children from Environmental Health Risks and Safety Issues (EO 13045) of 1997
Protection of Cultural Property (EO 12555) of 1986
Protection of Wetlands (EO 11990) of 1977
Reclamation Projects Authorization and Adjustments Act of 1992
Recreational Fisheries (EO 12962) of 1995
Resource Conservation and Recovery Act of 1976
Responsibilities of Federal Agencies to Protect Migratory Birds (EO 13186) of 2001
Rivers and Harbors Acts of 1899 and 1956
River and Harbor and Flood Control Act of 1970
Safe Drinking Water Act of 1974
Submerged Land Act of 1953
Sustainable Fisheries Act of 1996
Toxic Substances Control Act of 1976
Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970
Water Resources Development Acts of 1976, 1986, 1990, 1992, and 2007
Water Resources Planning Act of 1965
Watershed Protection & Flood Prevention Act of 1954
Water Pollution Control Act Amendments of 1972
Wild and Scenic River Act of 1968
Wilderness Act of 1964

Table J-2: Relevant Environmental State Statutory Authorities.

(Note: this list is not complete or exhaustive.)	
Air Control Act Archeological Treasury Act of 1974 Louisiana Coastal Resources Program Louisiana Scenic Rivers Act of 1988	Louisiana Threatened and Endangered Species and Rare & Unique Habitats Protection of Cypress Trees Water Control Act

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A
Annex K

Mitigation Plan

K.1 Mitigation

Mitigation planning was integrated into the plan formulation process by considering, individually and collectively, each of the NEPA mitigation actions (40 CFR 1508.20) of avoiding, minimizing, reducing and rectifying potential adverse impacts to all significant resources, to the extent practicable. Mitigation planning was accomplished using a watershed approach consistent with ER 1105-2-100 paragraph C-3(d)(3)(1) and CECW-PC memorandum dated August 31, 2009 entitled "Implementation Guidance for Section 2036 (a) of the Water Resources Development Act of 2007 (WRDA 2007) – Mitigation for Fish and Wildlife and Wetland Losses." Examples of the mitigation plan formulation considerations include:

- Avoiding: the PDT examined alternatives that would avoid potential impacts to wetlands by designing levee alignments which followed the wetland – non-wetland interface (e.g., Alternative A); and by developing non-structural measures such as structure raising, acquisitions of structures.
- Minimizing: the PDT screened out measures and alignments that could cause potential adverse impacts but had no additional storm damage risk reduction benefits (e.g., alignments along Lakes Pontchartrain and Maurepas).
- Rectifying: the PDT developed measures for rectifying adverse impacts of restricting tidal exchange (e.g., culverts under the levee which would provide tidal exchange).
- Reducing: the PDT developed the levee system to simulate the existing hydrologic connectivity. Pumps are included in the system and would only be operated during the approximately 1.7 storm events per year and would be closed for only approximately 8.5 days per year. Consequently, hydrologic connectivity would be generally maintained with the surrounding swamps and Lakes Maurepas and Pontchartrain, except during the closing of the system for hurricane and tropical storm events in the area as described in the Main Report.

Although mitigation planning was integrated into the overall alternative plan formulation process, implementation of the Tentatively Selected Plan – Alternative C requires compensatory mitigation for unavoidable project-induced impacts which will require replacing or providing substitute resources. This section, in conjunction with **Appendix A** (Mitigation Plan when developed), serves as the mitigation plan for the Tentatively Selected Plan – Alternative C, as required by 33 CFR 332.4(c) and 40 CFR 230.92.4(c).

K.1.1 Water Quality Mitigation

Construction of the proposed project would follow best management practices (BMPs) to minimize the introduction of suspended solids into surrounding waters during project construction. BMPs could include such practices as the use of siltation fences and hay bales to reduce erosion at construction sites, vegetated buffers, spill boxes with settlement devices, coffer dam and others. Requirements to comply with BMPs would be included in, and made part of, construction contracts.

K.1.2 Wetland Mitigation

An interagency Habitat Evaluation Team (HET) was formed to use habitat assessment methodologies to assess the quality of wetlands of the project area and mitigation areas, make a determination of the various project-induced impacts on future conditions, and determine mitigation required to compensate for unavoidable impacts caused by the constructible project features. The HET was composed of representatives from the USFWS, NMFS, USACE, USEPA, LDWF, LDEQ, and LDNR.

Because a feasibility-level habitat analysis, i.e., Wetland Value Assessment (WVA) methodology has not yet been conducted, a preliminary habitat assessment was conducted using Coastwide Reference Monitoring System (CRMS). The CRMS is a multiple reference approach that uses aspects of hydrogeomorphic functional assessments and probabilistic sampling (source: http://lacoast.gov/crms2/home.aspx accessed May 9, 2013). This approach includes a suite of sites that encompass the range of ecological conditions for each stratum, with projects placed on a continuum of conditions found for that stratum. Trajectories in reference sites are then compared with project trajectories through time. As indicated on the website, this approach could serve as a model for evaluating wetland ecosystems.

A brief description of the preliminary habitat assessment methodology utilizing CRMS data, analysis, and assumptions may be found in **Section** 4.3.2 **Vegetation Resources**. Detailed feasibility-level project design will be conducted on Alternative C (TSP) following release of the draft Integrated Feasibility Report and EIS; following which, habitat impact assessment utilizing the Wetland Value Assessment (WVA) methodology will be utilized for a more through habitat analysis of project impacts and compensatory mitigation requirements and included in the final Integrated Feasibility Report and EIS.

K.1.3 Mitigation Plan

The Mitigation Plan will be designed to compensate for unavoidable project-induced impacts (both direct and indirect) to significant environmental resources, such as wetland habitats. At the present level of design, Alternative C (TSP) would directly impact a total of approximately 719 acres of forested wetlands/swamp and 55 acres of dry and/or wet BLH habitats and could indirectly impact up to approximately 8,424 acres of primarily forested wetlands/swamp habitats. However, feasibility-level project design and habitat evaluation and analysis remain to be completed. Based on information that is currently available, compensatory mitigation may be required for a total of up to 9,143 acres of forested wetlands/swamps and BLH habitats. It is anticipated that feasibility-level hydrologic exchange modeling and subsequent project designs and operation schemes will include sufficient project features, such as hydrologic exchange features (e.g., culverts within the levee) thereby reducing potential indirect impacts to enclosed wetlands.

The CRMS analysis used to determine TSP impacts had an average Floristic Quality Index (FQI) of 19.7859, a Hydrologic Index (HI) of 0.864 and a combined average (FQI + HI) score of

0.53093 (**Table K-1**). The FQI score for the TSP was compared to both the Pontchartrain Basin Scale and Coastwide Scale FQI scores of 2006 through 2012. The TSP FQI and HI score comparisons to the Pontchartrain Basin and Coastwide Scales indicates that resources impacted by the TSP are within the < 25th percentile and therefore characterized as poor quality habitat. However, the FQI is based upon herbaceous vegetation (understory), not the canopy and/or midstory (trees). Therefore, characterization of the project area as poor quality habitat maybe an undervalued estimation of the actual habitat quality of forested wetland/swamp habitat in the project area. The TSP HI score compared to the Pontchartrain Basin Scale and Coastwide Scale HI scores of 2007 through 2012, indicates that resources impacted by the TSP fall within the 25th – 75th percentile range and is characterized as fair (source: http://www.lacoast.gov/chartingwebservices2/report_cards/CRMS5373_2013_ReportCard.pdf accessed May 9, 2013). Utilizing a similar percentile classification scheme approach for classifying the combined FQI + HI scores, Alternative C (TSP) would be characterized as fair quality or better habitat; this characterization is similar for all other final array alternatives (see **Section 4.3.2 Vegetation Resources).**

Based on the CRMS habitat quality determination, assumptions for mitigation replacement ratios would range between 1.5:1 acres under the best case scenario and 4:1 acres under the worst case scenario. However, due to the availability of only preliminary hydrologic flow and inundation comparisons between the No Action Alternative and Alternative C (TSP), a different approach was required to determine potential mitigation acreage and costs estimates. This approach was taken because of the uncertainties of Alternative C (TSP) performance, the unknown potential for significant indirect impacts, and utilizing a risk-based habitat quality methodology (CRMS analysis). The rough order of magnitude mitigation impacts and associated costs are presented in **Table K-1**.

K.1.3.1 Compensatory Mitigation Alternatives

Compensatory mitigation alternatives included consideration of purchasing mitigation credits from approved mitigation banks and various USACE constructed in-kind mitigation features. Section 2036 (c)(1) of the WRDA 2007 requires that where appropriate and where impacts are located within the service area of an approved mitigation bank, the USACE first consider using commercial mitigation banks to provide compensation for impacts to wetlands. The USACE determined the use of mitigation banks was not feasible because the project area is not located within the service area of approved mitigation banks with credits for forested wetlands and swamps were located in the vicinity of the project area.

Thus, the mitigation alternative selected will consist of USACE-constructed features whereby degraded forested wetlands/swamp and BLH habitats would be restored/created within the adjacent Maurepas Swamp to the extent practicable. When completed, the mitigation appendices will contain detailed description of the mitigation plan proposed to compensate for unavoidable, project-induced direct and indirect impacts of implementing the Tentatively Selected Plan.

**Table K-1. Estimated direct and indirect impacted acres
And costs for all alternatives**

DIRECT MITIGATION COSTS				
	acres	**Max Cost**	**Min Cost**	**Average Cost**
Alternative A	377	$29,786,198	$4,215,383	$17,000,791
Alternative C	775	$62,664,599	$8,757,023	$35,710,811
Alternative D	1,115	$75,645,552	$11,001,176	$43,323,364
INDIRECT MITIGATION COSTS				
	Hab value reduction	**Max Cost**	**Min Cost**	**Average Cost**
Alternative A				
3,564	75%	$201,877,610	$29,359,178	$115,618,394
	50%	$134,585,074	$19,572,785	$77,078,929
	25%	$67,292,537	$9,786,393	$38,539,465
	15%	$40,375,522	$5,871,836	$23,123,679
	10%	$26,917,015	$3,914,557	$15,415,786
	5%	$12,953,096	$1,957,279	$7,455,187
Alternative C				
8,424	75%	$477,165,261	$69,394,421	$273,279,841
	50%	$318,110,174	$46,262,947	$182,186,560
	25%	$159,055,087	$23,131,474	$91,093,280
	15%	$95,433,052	$13,878,884	$54,655,968
	10%	$63,622,035	$9,252,589	$36,437,312
	5%	$31,811,017	$4,626,295	$18,218,656
Alternative D				
56,228	75%	$2,860,824,840	$416,051,416	$1,638,438,128
	50%	$1,907,216,560	$277,367,610	$1,092,292,085
	25%	$953,608,280	$138,683,805	$546,146,043
	15%	$572,164,968	$83,210,283	$327,687,626
	10%	$381,443,312	$55,473,522	$218,458,417
	5%	$190,721,656	$27,736,761	$109,229,209
TOTAL MITIGATION COSTS				
Direct + Indirect Impacts				
Alternative A	**Hab value**	**Max Cost**	**Min Cost**	**Average Cost**
3,941	75%	$231,663,808	$33,574,561	$132,619,185
	50%	$164,371,272	$23,788,168	$94,079,720
	25%	$97,078,735	$14,001,776	$55,540,255
	15%	$70,161,720	$10,087,219	$40,124,469
	10%	$56,703,213	$8,129,940	$32,416,576
	5%	$42,739,294	$6,172,662	$24,455,978
Alternative C				
9,199	75%	$539,829,860	$78,151,444	$308,990,652
	50%	$380,774,773	$55,019,970	$217,897,371
	25%	$221,719,686	$31,888,497	$126,804,091
	15%	$158,097,651	$22,635,907	$90,366,779
	10%	$126,286,634	$18,009,612	$72,148,123
	5%	$94,475,616	$13,383,318	$53,929,467
Alternative D				
57,343	75%	$2,936,470,392	$427,052,592	$1,681,761,492
	50%	$1,982,862,112	$288,368,787	$1,135,615,449
	25%	$1,029,253,832	$149,684,982	$589,469,407
	15%	$647,810,520	$94,211,460	$371,010,990
	10%	$457,088,864	$66,474,699	$261,781,781
	5%	$266,367,208	$38,737,938	$152,552,573
Notes: Max cost is based on Morganza to the Gulf and HSDRSS LPV Mitigation estimates				
Minimum cost are based on New Orleans District mitigation bank cost for swamp and BLH				
Mitigation bank will not likely have sufficient availability for the large-scale needs of WSLP mitigation				
Includes mitigation, monitoring, and 25% contingency cost				
Habitat quality based on CRMS sites quality indices.				

Topics addressed in the mitigation plan will include:

- Conceptual ecological model.
- Mitigation objectives (including determination of mitigation credits).
- Mitigation success criteria (performance standards).
- Mitigation work plan.
- Mitigation plans and specifications
- Mitigation maintenance and management plan.
- Mitigation monitoring and reporting requirements (including estimated monitoring/reporting cost).
- Adaptive Management Plan.
- Land acquisition and preservation/protection of mitigation features.
- Financial assurances.

Following feasibility-level design of Alternative C (TSP), updated baseline wetland characterization information, from WVA assessments, will be conducted for both the proposed action area and mitigation sites. This updated analysis and documentation will be provided in **Section 4.3.2 Vegetation Resources** and in the **Appendix A** of the Final Integrated Feasibility Report and EIS.

The following lists and drawings depict conceptual mitigation ideas and boundaries of potential mitigation areas. More area than may potentially be required has been identified in the conceptual figures to allow for potential shift in mitigation feature locations due to unforeseen circumstances.

The WRDA of 2007, Section 2036 (a); and implementation guidance CECW-PC 31 August 2009 Memorandum: “Implementation Guidance for Section 2036 (a) of the WRDA 2007 – Mitigation for Fish and Wildlife and Wetland Losses” requires adaptive management (AM) and monitoring be included in mitigation for fish and wildlife and wetland losses. A fully developed Adaptive Management and Monitoring Plan (AM&M Plan) will be provided in the appendices of the final Integrated Feasibility Report and EIS.

Proposed compensatory mitigation actions would include construction, with the NFS responsible for 100 percent of the OMRR&R, of functional elements of mitigation features as they are completed. On a cost-shared basis, the USACE would monitor completed mitigation features to determine whether additional adaptive management actions are necessary to achieve mitigation (ecological) success. The USACE would undertake additional actions necessary to achieve mitigation success in accordance with cost-sharing applicable to the project and subject to the availability of funds. Once the USACE determines that the mitigation has achieved initial success criteria, monitoring would be performed by the NFS as part of its OMRR&R obligations. If, after meeting applicable initial mitigation success criteria, the mitigation feature fails to meet its other mitigation success criteria, USACE would consult with other agencies and the NFS to determine whether operational changes would be sufficient to achieve the mitigation success criteria. If, instead, structural changes are deemed necessary to achieve mitigation success, USACE would instruct the NFS to implement appropriate adaptive management measures in accordance with the AMP (contingency plan) subject to OMRR&R cost-sharing requirements, availability of funding, and current budgetary and other guidance.

K.1.3.2 Wetland Mitigation Plan

Table K-1 provides a preliminary estimation of the direct and indirect habitat acreage impacts that could result from construction and implementation of Alternative C (TSP). Because of the uncertainty of project-specific impacts, the following conceptual mitigation measures being considered will be further developed and designed during the feasibility-level analysis phase of this study. The following proposed mitigation sites depict conceptual boundaries that could serve as mitigation for project-induced forested wetland/swamp and BLH habitat impacts. The proposed mitigation measures are conceptual and do not necessarily reflect boundaries of mitigation measures that may ultimately be included in the completed Wetland Mitigation Plan which will be included in **Appendix A** to the final Integrated Feasibility Report and EIS.

Because of the recognized Federal interest and demonstrated need for restoration within the Maurepas Swamp (e.g., the Maurepas Swamp Diversions), the USACE proposes to establish mitigation features for the WSLP project within degraded portions of the Maurepas Swamp. The LDWF and USFWS have, independently, recognized the importance of implementing mitigation in the Maurepas Swamp to complement river reintroductions and have made the similar recommendations.

<u>Louisiana Department of Wildlife and Fisheries Mitigation Proposals</u>

Mitigation measures identified by LDWF (personal communication Mrs. Kyle Balkum and Brad Mooney, LDWF, May 23, 2013) aim to enhance or improve surface hydrology until such time that river reintroductions into the Maurepas Swamp are constructed. The LDWF indicate these mitigation measures are still conceptual and will require further planning, design and engineering. LDWF also prioritized each measure (i.e., High, Medium or Low) to inform the PDT on which measures are believed to be most beneficial (see **Figure K-1**).

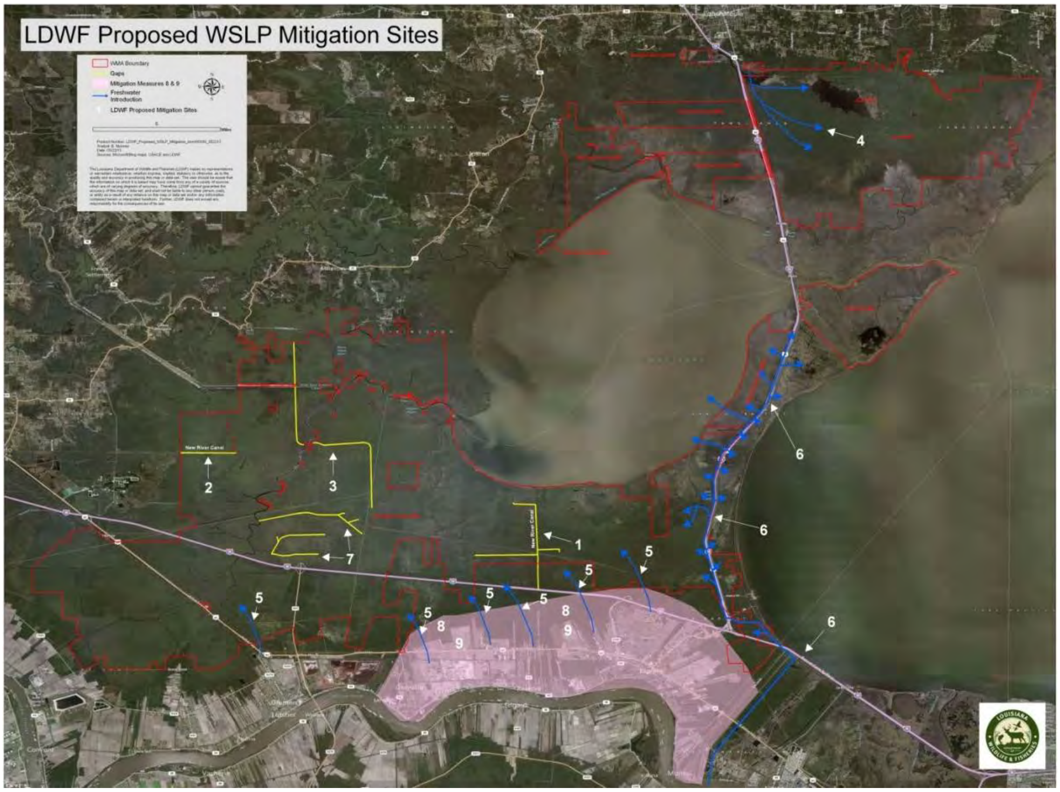


Figure K-1: Louisiana Department of Wildlife and Fisheries proposed mitigation sites

The number of the LDWF proposed mitigation measure described below corresponds with the number displayed on **Figure K-1**.

1. Gap spoil banks along Reserve Relief Canal (High priority).
2. Gap spoil banks along New River Canal (High priority).
3. Gap/degrade railroad bed which traverses the swamp beginning from Hope Canal and proceeding north and west to the northern property boundary (crossing Blind River and Amite River Diversion Canal (High priority).
4. Improve through flow of Hammond wastewater into existing Joyce WMA outfall area (High priority).
5. Make efficient use of storm water and wastewater produced by communities south of I-10 (e.g., Laplace, Ascension Parish) by distributing this water into the Maurepas Swamp (High priority).
6. Diversion of freshwater from Bonnet Carre Spillway guide levee to the swamps and marshes to the northwest (Medium priority).
7. Gap any spoil banks north of I-10 in the area of Tennessee Williams (Medium priority).
8. Preserve existing wetlands by acquiring land in fee title that is enclosed within the levee (Low priority).
9. Restrict development in wetlands enclosed within the levee (Low priority).

Other Potential Mitigation Measures

Figure K-2 displays other potential mitigation sites within the Maurepas Swamp that will also be considered. USACE-constructed mitigation features would be located and constructed in a manner that avoids adverse impacts to existing wetland habitats to the greatest degree practicable. Any unavoidable adverse impacts to existing wetland habitats or to other habitats would be fully compensated as part of the mitigation plan, as necessary.

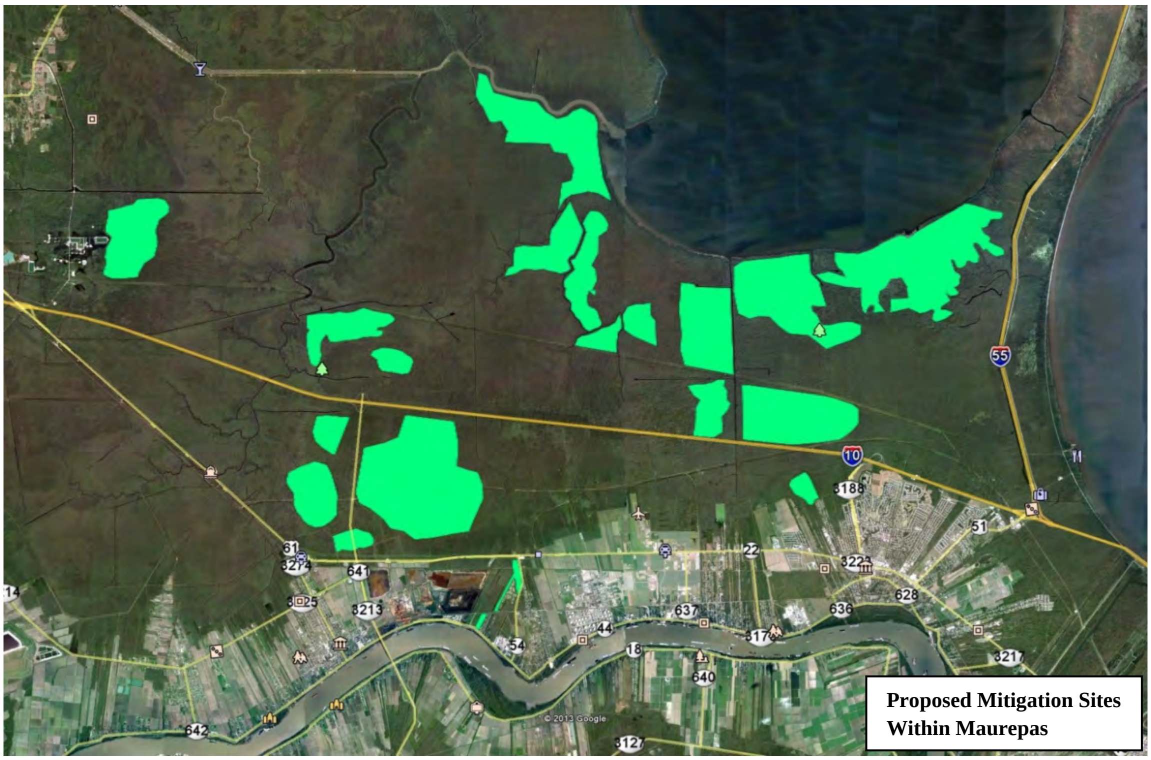


Figure K-2: Proposed mitigation sites within Maurepas Swamp

Analysis conducted in the LCA ARDC and LCA CBRD restoration projects (USACE 2010a and 2010b), determined that changes in surface hydrology attributable to both natural (e.g., subsidence and sea level rise) and man-made (e.g., logging practices, levees along the Mississippi River and Tributaries) forces have synergistically interacted to restrict annual river storm damaging inputs of sediments and nutrients and impound vast areas of the Maurepas Swamp thereby resulting in the conversion of existing forested wetlands/swamp habitats to marsh and open water within 10 to 50 years. Therefore, consistent with resource agency recommendations, mitigation measures would enhance or improve surface hydrology and restore degraded forested wetlands/swamp habitats to complement authorized river reintroductions into the Maurepas Swamp as constructed.

The following examples of proposed mitigation measures would be similar to the restoration efforts of the LCA ARDC project. Conceptual examples of some the below proposed measures are also presented.

- Breach Hydrologic Barriers: breach existing hydrologic barriers (e.g., old railroad beds, spoil banks along canals used for logging and storm damage relief canals) to re-establish hydrologic connectivity in selected hydrologic subunits throughout the Maurepas Swamp (see **Figure K-2**).
- Vegetative Planting: areas where inundation and storm damaging prevents or limits natural regeneration of the cypress-tupelo forest, artificial regeneration through tree planting may be the only viable method to regenerate the most degraded portions of the Maurepas Swamp. Identified mitigation areas (**Figure K-2**) are degraded to the point where the canopy, mid-story, and established regeneration is limited or severely stressed. Some portions of the Maurepas Swamp are altered to such a significant extent that even artificial regeneration may not be possible and it may be necessary to conduct this mitigation measure along with other proposed mitigation measures. Vegetative planting to restore bald cypress-tupelo communities at targeted mitigation sites, i.e., the most degraded areas in the Maurepas Swamp (**Figure K-2**), would contribute to preventing habitat conversion and future land loss, increasing swamp vegetative productivity, and restoring and preserving wildlife habitats. Vegetative plantings would serve as a means of creating a seed source in the mitigation sites for future regeneration. Vegetative plantings would be conducted by hand and would have no significant direct impacts on existing wetland resources, but would contribute to the improved health of the freshwater swamp system. Vegetative plantings would also increase the potential for reversing on-going habitat conversion (see LCA ARDC and LCA CRBD) and would further stabilize targeted degraded portions of the Maurepas Swamp in addition to providing compensatory migration. Plantings would be implemented in two phases:

    - A primary or initial planting would be implemented in the designated mitigation areas concurrent with construction of Alternative C (TSP) project features. Approximately 16 months after primary plantings are established; a mortality analysis would be conducted to establish the quantity of plantings required for the secondary planting.
    - It is assumed that 50 percent of the primary plantings would perish. Four months after this determination is made, a secondary planting would be implemented. Based on experience with the LCA ARDC project for similarly degraded areas, both the primary and secondary plantings would consist of 173 trees per acre. Each acre planted would be composed of 75 percent bare-root, 15 percent one-gallon potted, and 10 percent three-gallon potted plants. These plantings are considered an important component of the mitigation design, due to the native regeneration they would likely provide for the highly degraded areas selected for mitigation. The plantings should only occur during the non-growing season (November to March). Vegetative plantings would provide compensatory mitigation by increasing the acreage of forested wetlands/swamp habitats used by fish and wildlife for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements. In addition, the increased vegetation growth and productivity would reduce inter- and intra specific competition between resident and migratory fish and wildlife species for limited coastal forested wetland/swamp habitat resources. Areas where inundation and storm damaging prevents or limits natural regeneration of the cypress-tupelo forest, artificial

regeneration through tree planting may be the only viable method to regenerate the swamp.
  - o Vegetative plantings of native trees are necessary to become reestablished and overcome competition from exotic and invasive species, such as Chinese tallow trees. In addition, nutria exclusion methods will be required for all plantings to prevent nutria from damaging or killing newly-planted seedlings.

- Ridge Habitat: Use portions of railroad beds as ridge habitat and re-vegetate with BLH plan species (e.g., oaks). Plantings would be conducted similar, but with BLH species such as oaks, to the above described forested wetland/swamp plantings. BLH species would provide significantly more mast than forested wetland/swamp species.
- Invasive Species Control: control/eradicate invasive species specifically Chinese tallow and nutria. Methods to control nutria could include: exclusion, repellants, toxicants, trapping, and shooting. Chinese tallow control could include treatments using the herbicide injection system, frill cut and spray (Roundup or Arsenal) and basal stem sprays with triclopyr. Seedlings may be burned, hand pulled and foliar sprays.
- Wastewater Introduction: introduce wastewater from local municipal wastewater as a means of adding nutrients to the forested wetlands/swamp habitat. An increase in nutrients provided to areas presently impounded and therefore cut off from any nutrient supply nutrients would increase the production of tree species.
- Clearing and Snagging: clearing and snagging of natural waterways, as well as old logging canals at various locations within the hydrologic subunits thereby contributing to establishing hydrologic connectivity, allowing seasonal drying and promoting water circulation to improve water quality.
- Channel Dredging: channel dredging of natural waterways and storm damage relief channels at various locations within hydrologic subunits could contribute to establishing hydrologic connectivity, allowing seasonal drying and promoting water circulation to improve water quality.
- Spray Dredging: Spray dredging of proposed mitigation sites in which dredged material is broadcast within a specific area in order to supplement vertical accretion. This measure could preventing habitat conversion and future land loss due to RSLR as well as restore and preserve wildlife habitats.
- Habitat Creation via Placement of Dredged Material: Working in concert with the above proposed dredging actions, the placement of dredged material as additional upland and bottomland hardwood habitat could serve as refuge various wildlife during high-water events while also providing areas to implement supplemental plantings of BLH tree species.
- Synergistic Interactions with LCA ARDC and LCA CBRD: implement combinations of the above described measures for specifically targeted areas adjacent to, but outside of, the authorized LCA ARDC and LCA CBRD projects in order to work more synergistically with these authorized restoration projects.
- Project-Enclosed Wetlands: Improve through flow of Laplace, Reserve and other municipal wastewater into adjacent forested wetlands/swamp habitats, including those habitats that would be enclosed by the Tentatively Selected Plan.
- Restore Hydrologic Connections: Placement of cuts or gaps in existing railroad grades and storm damage relief channel spoil banks would provide further hydrologic connectivity thereby draining impounded water from inundated areas of the swamp and restore hydrologic connectivity with the surrounding area and Lake Maurepas. Openings would promote the introduction of freshwater, sediments, and nutrients into the swamp and allow the oxidation of sediments and removal of toxic metabolites thereby improving degraded swamp stands and

decreasing the transition to marsh and ultimately, open water. Once hydraulic connection is restored within the degraded mitigation area, tree vigor and stand productivity should increase (Shaffer et al. 2009). Identified mitigation areas (**Figure K-3**) are degraded to the point where the canopy, mid-story, and established regeneration is limited or severely stressed due to impoundment and lack of hydrologic connectivity.

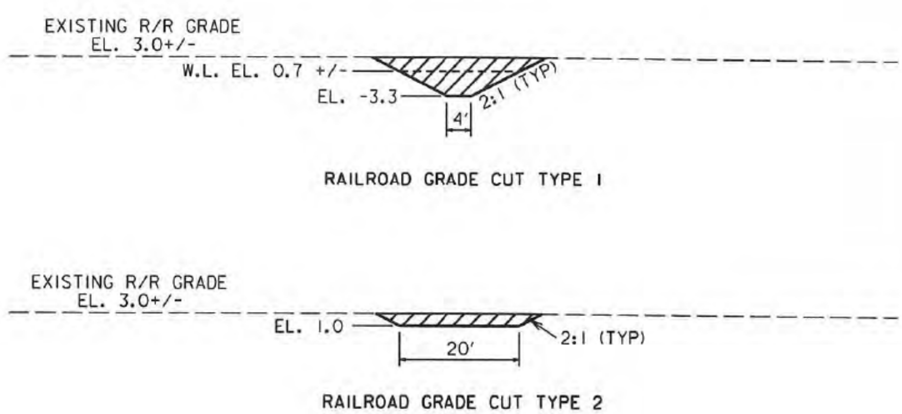


Figure K-3: Conceptual railroad/spoil bank cut (adapted from LCA ARDC (USACE 2010a)

These proposed mitigation measures were adapted from the development of the LCA ARDC restoration project located in the western Maurepas Swamp . Vegetative plantings and invasive species control, in conjunction with reestablishing hydrologic connectivity, would help to reestablish a productive stand and adequate canopy cover where natural regeneration would not likely occur and before the effects of RSLR permanently inundated the system. Permanent inundation would prevent planted or naturally regenerated species from becoming established. However, a multi-mitigation measure approach should allow for success.

K.1.3.3 Mitigation Implementation Commitments

USACE-constructed mitigation features necessary to fully compensate for unavoidable direct and indirect project-induced impacts would be implemented concurrent with construction of the project The exact sequencing and schedule for construction of the various project mitigation features cannot be accurately estimated at this time.

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A
Annex L

Adaptive Management and Monitoring Plan

Incorporation of Adaptive Management and Monitoring (AM&M) activities during the life-cycle of the Mitigation Project will address ecological and other uncertainties that could prevent successful implementation of mitigation project measures once developed. The AM&M Plan will establish a framework for decision-making that utilizes monitoring results and other information, as it becomes available, to update project knowledge and adjust mitigation management actions through a deliberate adaptive management program. Integration of AM&M into the mitigation project will ensure success under a wide range of conditions and enable implementing corrective actions in cases where monitoring demonstrates that the mitigation project or measures are not achieving ecological success.

An AM&M Plan will be developed for the mitigation plan consistent with the requirements of the WRDA 2007, Section 2036 (a) and implementation guidance (CECW-PC 31 August 2009 Memorandum: "Implementation Guidance for Section 2036 (a) of the Water Resources Development Act of 2007 (WRDA 2007) – Mitigation for Fish and Wildlife and Wetland Losses" and included as part of the mitigation plan in the final Integrated Feasibility Report and EIS appendices. Section 2036(a) requires an AM plan (Contingency Plan) be appropriately scoped to the project scale and if the need for a specified adjustment is anticipated, due to high uncertainty, the nature and costs for AM actions should be explicitly described as part of the decision document. Information provided by the monitoring plan will be used by the District Engineer and Division Commander to guide decisions on operational and or structural changes that may be needed to insure the mitigation project or measures meet success criteria. Identified physical modifications to mitigation features will be cost-shared and must be agreed upon by the local non-Federal sponsor. AM plan costs should be shown in the 06 feature code of the cost estimate. Any changes to the AM plan approved in the decision document must be coordinated with USACE Headquarters. Significant changes needed to achieve ecological success that cannot be addressed through operational changes or are not included in the approved AM plan may be examined under other authorities.

The AM&M Plan elements will include:

- The organizational structure for the AM&M process
- Conceptual Ecological Model
- Key project uncertainties
- Evaluation of mitigation measures and alternatives as candidates for AM actions
- Identification of potential AM actions and description of the monitoring design developed to evaluate progress towards meeting the identified mitigation success criteria

L.1.1 AM&M Planning Process

The AM&M Plan framework includes both a Set-up Phase, which proceeds concurrently with the planning process and development of the mitigation plan; and an Implementation Phase which puts the AM&M Plan into action. The Mitigation Project will be designed, constructed, monitored, and assessed to determine mitigation success. The AM&M Plan will utilize monitoring results to understand ecological system responses to mitigation actions and compared to stated targets, goals, objectives and success criteria. Leadership will then decide one of two actions: (1) alter specific mitigation measures or the entire mitigation project utilizing AM actions to improve mitigation project/measure performance based on assessment results; (2) declare mitigation (ecological) success and implement OMRR&R.

L.1.2 Conceptual Ecological Model

A Conceptual Ecological Model (CEM) will be developed that identifies major stressors and drivers affecting each proposed mitigation measure. A CEM is a simple qualitative model that usually diagrams general ecosystem relationships between major anthropogenic and natural stressors, biological indicators, and target ecosystem conditions. The CEM will not try to explain all possible relationships of potential factors influencing the mitigation sites. Rather, the CEM will develop and present only those relationships and factors deemed most relevant to obtaining mitigation success.

L.1.3 Performance Measures, Success Criteria and Adaptive Management Triggers

The CEM will be used to determine performance measures, success criteria and AM triggers for determining mitigation/ecological success and if, and when, AM actions are required. Performance measures are indicators of progress toward a goal, objective, or target. The endpoint “Mitigation/Ecological Success” will be used by the Division Commander to determine when ecological success has been achieved. All performance measures and success criteria will be based on the mitigation project’s goals, objectives, and the stressors and attributes identified in the conceptual models and should: (1) be measurable; (2) have a relatively strong degree of predictability; (3) change in response to project implementation; and (4) verify progress and evaluate hypotheses through monitoring and assessment (Fischenich et al., 2012).

AM decision criteria/triggers will be used to determine if and when AM actions should be implemented. AM triggers are specific values of monitored parameters used in evaluating the mitigation project/measure(s) performance. Criteria will be developed to determine if the monitoring results support continued implementation of the mitigation project/measure(s) as designed, or if adaptive management actions should be undertaken.

Once the mitigation project/measure(s) are constructed and implemented they will be monitored against these decision criteria/triggers. Once a mitigation project/measure(s) meets or exceeds the established criteria/trigger, an AM action would be recommended to alter project performance (i.e., structural or operational changes). In some cases, additional modeling or experimental efforts may be required to understand and manage the observed ecological responses before a recommendation for a potential AM action can be made.

Below is an example of the typical performance measures, success criteria and thresholds/targets that would be considered during the feasibility-level analysis phase of this study:

Objective 1: Mitigate for project-induced impacts by creating 3,000 acres of forested wetlands/swamp and BLH habitat.

Performance Measure 1a: Swamp vegetation production and extent.
Desired Outcome: Increase in basal area increment of baldcypress & tupelo in the swamp from existing conditions
Monitoring Design: Diameter at breast height (dbh) and overstory tree cover will be measured in the fall in two pre-construction years and four post-construction years (within the first 10 years).
Performance Measure 1b: Number of baldcypress and tupelo saplings
Desired Outcome: A 25% increase in the number of naturally recruited baldcypress and tupelo saplings per acre from pre-project conditions ten years after project implementation. Performance of this measure is most dependent on achieving extended dry periods in the swamp. Existing conditions defined from WVA pre-mitigation planting measurements.
Monitoring Design: Understory vegetation (herbaceous, seedling, and sapling) will be measured in the fall in one pre-mitigation planting and four post-mitigation planting years (within the first 10 years) to assess regeneration and changes in cover classes
Performance Measure 2: Species composition and percent cover for vegetation plantings in permanent plots and transects.
Success Criteria (Desired Outcome): Generally, increase in percent cover in vegetation plots. 1) At 4 years post construction, attain at least 80% survival of planted species, or achieve a minimum cover of 50% comprised of native herbaceous (including planted and volunteer species). 2) Year 6 maintain 75% native cover, 3) years 7-27 maintain 80% native vegetation cover
Threshold/Trigger: If the identified success criteria are not met there may be a need for an adaptive management actions including replanting of areas that no longer meet success criteria and or replanting of areas that required topographic alterations.

L.1.4 Key Sources of Uncertainty and Associated Risks

A fundamental tenet of AM is decision making and achieving desired mitigation project outcomes in the face of uncertainties. There are many uncertainties associated with mitigation/restoration of coastal ecosystems. Uncertainties for the mitigation project/measure(s) will be documented and incorporated into the final mitigation plan as well as the adaptive management and monitoring planning. Examples of some key sources of uncertainty and risks that are expected to be relevant include:

- Climate change such as drought conditions and variability of tropical storm frequency, intensity, and timing
- Relative sea level rise, subsidence, salinity, and water level trends
- Subsidence rates (+/-) throughout the mitigation project life
- Water level trends (+/-) throughout the mitigation project life
- Water, sediment, and nutrient requirements
- Magnitude and duration of wet/dry cycles for swamp

- Nutrients required for desired productivity
- Growth curves based on hydroperiod and nutrient application
- Tree and marsh litter production based on nutrient and water levels
- Tree propagation in relation to management/regulation of hydroperiod
- Self-Sustainability of Project Once Ecological Success Criteria are Achieved

L.1.5 Adaptive Management Evaluation

Mitigation project/measure(s) will be evaluated against the need for AM actions. All restoration and mitigation projects are required to consider AM; however, there may be some mitigation projects/measures for which AM is not applicable. Adaptive management is warranted when there are consequential decisions to be made, there are high uncertainties, when there is an opportunity to apply learning, when the value of reducing uncertainty is high, and when a monitoring system can be put in place to reduce uncertainty. In cases where AM is not warranted, the mitigation project would still develop an AM Plan but the plan would clearly describe the rationale as to why AM actions would not be warranted. A mitigation project where AM is not warranted would still contain a Monitoring Plan to measure project success. The mitigation project/measures will be evaluated against the potential need for AM actions.

L.1.6 Monitoring for Ecological Success

A Monitoring Plan will be developed including each mitigation project measure and habitat type within the Mitigation Plan to determine if the project mitigation is ecologically successful. The Monitoring Plan will identify the monitoring design and protocols, the schedule for the monitoring events and the specific content for the monitoring assessment reports that will measure progress towards meeting the success criteria. Upon completion of each mitigation project measure, monitoring for ecological success will be initiated and continued until ecological success, as defined by the mitigation success criteria, is achieved for each mitigation measure and the overall mitigation project. Typical monitoring elements for swamp and BLH would include:

- Aerial imagery
- Vegetation surveys: species composition, diameter breast height (DBH), percent coverage, regeneration, mortality
- Land/water and habitat classifications
- Hydrological surveys—water level, salinity, temperature, dissolved oxygen; and
- Surface elevation, subsidence and accretion

L.1.7 Potential AM actions

To better ensure successful performance of mitigation measures, future scenarios for the mitigation project/measures will be based on identified critical uncertainties (e.g., salinities, wetland hydrology, inundation, increased subsidence, reduced accretion, and RSLR, etc.). Potential AM actions that would be incorporated should monitoring reports indicate success criteria are not being achieved and adjustment of mitigation measure(s) is needed could include:

- Renourishment of wetland areas (i.e. add additional fill to increase elevation)
- Vegetative plantings
- Hydrologic adjustments to depth, duration and frequency of storm damaging

L.1.8 Adaptive Management and Monitoring Responsibility

The USACE and the NFS will be responsible, on a cost shared basis for conducting baseline monitoring, subsequent project/measure monitoring and preparing monitoring reports until such time that mitigation initial success criteria are achieved. Once specified success criteria are achieved, the NFS will be solely responsible for conducting all subsequent monitoring and preparing the associated monitoring reports.

Proposed compensatory mitigation actions would include construction, with the NFS responsible for 100 percent of the OMRR&R, of functional elements of mitigation features as they are completed. On a cost-shared basis, the USACE would monitor completed mitigation features to determine whether additional adaptive management actions are necessary to achieve mitigation (ecological) success. The USACE would undertake additional actions necessary to achieve mitigation success in accordance with cost-sharing applicable to the project and subject to the availability of funds. Once the USACE determines that the mitigation has achieved initial success criteria, monitoring would be performed by the NFS as part of its OMRR&R obligations. If, after meeting applicable initial mitigation success criteria, the mitigation feature fails to meet its other mitigation success criteria, USACE would consult with other agencies and the NFS to determine whether operational changes would be sufficient to achieve the mitigation success criteria. If, instead, structural changes are deemed necessary to achieve mitigation success, USACE would instruct the NFS to implement appropriate adaptive management measures in accordance with the AMP (contingency plan) subject to OMRR&R cost-sharing requirements, availability of funding, and current budgetary and other guidance.

In the event the monitoring reports submitted to CEMVN reveal that any success criteria have not been met after the mitigation project is turned over and in the OMRR&R phase, the NFS, or its assigns after consultation with CEMVN and other appropriate agencies, will take all necessary measures to modify management practices in order to achieve these criteria in the future.

L.1.9 Costs

Costs will be developed for the AM&M program once a mitigation plan and specific mitigation measures have been fully developed. AM&M costs will include estimates for baseline and post-construction monitoring/data collection, data evaluation and assessment, data management, program management, reporting and identified potential AM actions.

These costs will be included in the overall construction budget. Monitoring/data collection costs for recent mitigation plans including the Morganza to the Gulf and HSDRSS LPV mitigation were estimated around $2,800/acre.

L.1.10 Mitigation Banks

In those instances when a Mitigation Bank is selected, the Mitigation Banking Instrument (MBI) sets forth the success criteria, mitigation monitoring and reporting requirements, and mitigation management and maintenance activities for each particular bank. In cases where the Mitigation Project involves purchase of credits from a mitigation bank, the bank sponsor (bank permittee) is responsible for these activities rather than the USACE and/or the NFS. USACE Regulatory staff review mitigation bank monitoring reports and conduct periodic inspections of mitigation banks to ensure compliance with mitigation success criteria stated in the MBI.

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A
Annex M

Water Quality Analysis

Table of Contents

List of Figures

List of Tables

1.0 Affected Environment

1.1 Introduction

This resource is institutionally significant because of the Clean Water Act, as amended, the Pollution Prevention Act, the Safe Drinking Water Act, and the Water Resources Planning Act, regulations which provide for the protection of U.S. waters for the purposes of drinking, recreation, and wildlife. This resource is technically significant for the purposes of restoring and maintaining the chemical, physical, and biological integrity of the Nation's waters. This resource is publicly significant because of the desire for clean water and water-related activities such as boating, swimming, fishing, and as a source of potable water for human and animal consumption.

1.1.1 Study Area Description

The study area is located in the southwestern portion of the Pontchartrain basin, a 9,700 square mile drainage basin connected to the Gulf of Mexico (Keddy et al. 2007). The northern basin includes sloping uplands, while the lower basin is estuarine, and in the northern limits of the Mississippi River delta plain (Blum and Roberts 2012). Primary surface water sources of the basin include the major tributaries of lakes Maurepas and Pontchartrain (the Tchefuncte, Tangipahoa, Amite-Comite, and Tickfaw rivers). Lakes Maurepas, Pontchartrain, and Borgne are the major estuarine embayments linking the basin to the Gulf of Mexico. Natural passes connecting these lakes include North Pass and Pass Manchac between lakes Maurepas and Pontchartrain, and Pass Rigolets and Chef Menteur Pass between lakes Pontchartrain and Borgne; the Inner Harbor Nagivation Canal (IHNC), Gulf Intracoastal Waterway (GIWW), and Mississippi River Gulf Outlet (MRGO) provide artificial connections between lakes Pontchartrain and Borgne, and the Gulf of Mexico (McCorquodale et al. 2009). The estuarine end of the basin also receives freshwater input from the adjacent Pearl River, and from episodic diversions of Mississippi River water for flood control. It includes swamp which transitions to marsh of increasing salinity regime eastward surrounding the lakes, followed by open bay and barrier islands at the eastern limits of the estuary.

The study area is bounded to the south and west by the Mississippi River, to the north by the St. James and St. John the Baptist Parish boundaries, and to the east by the western guide levee of the Bonnet Carré Spillway and the St. John the Baptist Parish boundary (Figure 1.1). This area, having a total footprint of approximately 234,000 acres, includes 1,250 acres of developed lands, 480 acres of undeveloped lands, approximately 113,000 acres of wetlands, and approximately 119,000 acres of open water.   Wetlands in the area are largely comprised of environmentally stressed second-growth bald cypress-tupelo swamp.

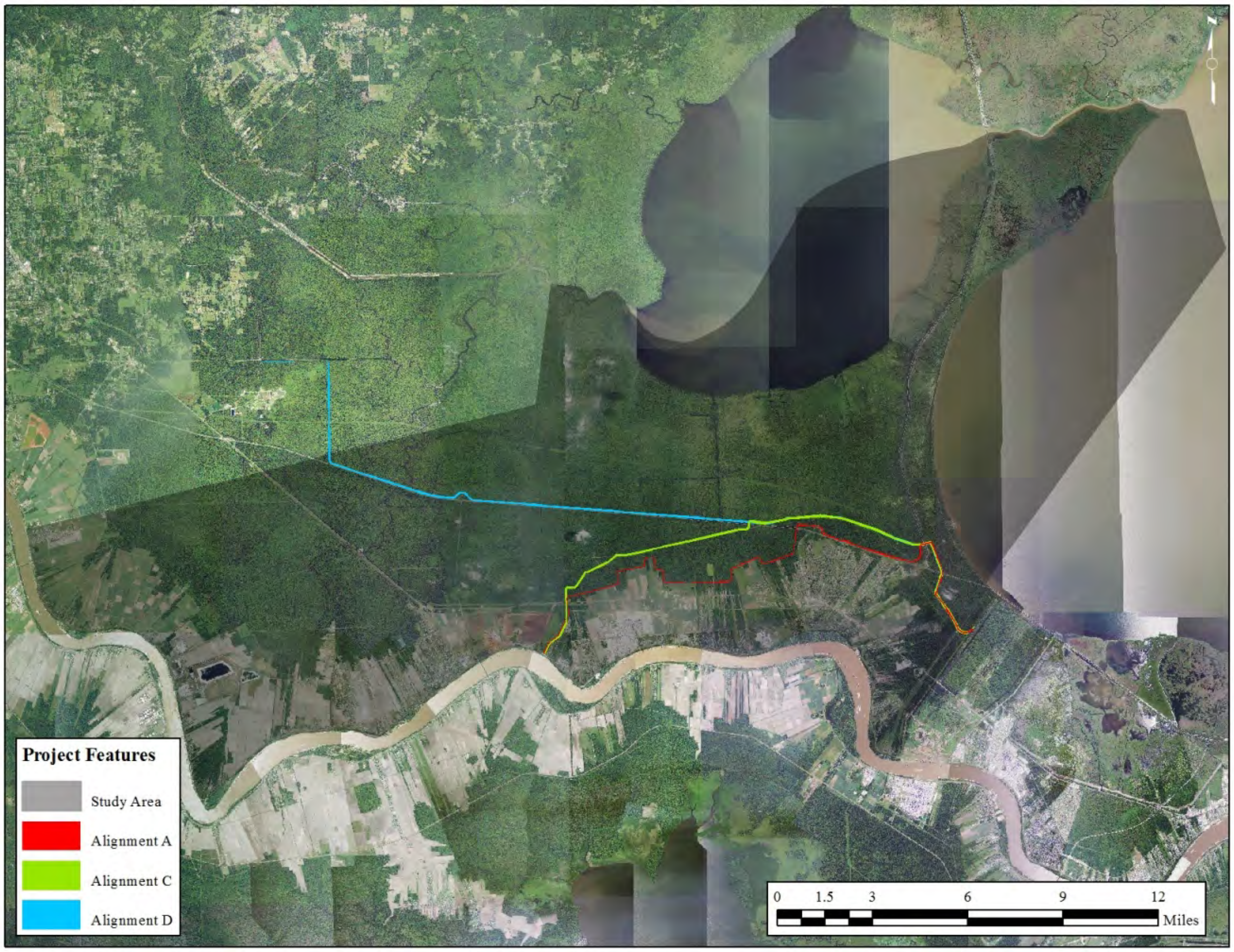


Figure 1.1. Study area and project alternatives.

1.1.2 Project Description

The proposed project is intended to provide hurricane storm damage risk reduction for communities on the east bank of the Mississippi River, in the parishes included in the study area (St. James and St. John the Baptist). The proposed levee alignment (Alignment C) is included in Figure 1.1; the proposed alignment includes the construction of approximately 21 miles of hurricane protection in the form of levees, t-walls, and miscellaneous gated structures. Because the proposed project would enclose adjacent wetlands, artificial drainage would be included in the project in the form of environmental water control structures, in order to reduce project impacts to water exchange between protected and flood side wetlands an waterbodies, in turn reducing project impacts to hydrology, biology, and water chemistry.

1.1.3 Study Area Water Quality Influences

Study area water quality is influenced by basin elevations, surface water budget, land cover and use, coastal and geological processes, and regional weather. The study area is in the southwestern portion of a basin consisting of uplands to the north and estuary to the south, with increasing estuary salinity eastward. As described in earlier, the basin is influenced by several rivers which provide freshwater to estuarine lakes connected to each other and, ultimately, to the Gulf of Mexico via several major passes.

The estuary has experienced hydromodification via the construction of canals and embankments. Major waterways within the estuary include the IHNC, MRGO, and GIWW. The estuary was formerly (1963-2009) connected to the Gulf of Mexico via the MRGO, which resulted in increased salinities (Sikora and Kjerive 1985; Tate et al. 2002); a rock barrier near Hopedale currently provides a disconnect at normal water levels. The estuary has also been subjected to canal construction for oil exploration and cypress logging (Keddy et al. 2007). These canals and their associated spoil banks can modify local flow and drainage patterns. Additionally, road and railroad beds, as well as hurricane protection features, provide hydraulic barriers within the estuary.

The basin includes upland forest and agricultural land north of the estuary, wetlands and open water within the estuary, development and agriculture along the Mississippi River corridor, and urban areas in greater New Orleans and Baton Rouge, and near the northern shorelines of lakes Pontchartrain and Maurepas (Demcheck et al. 2004). Tributaries of these lakes receive runoff from a mixture of non-developed, agricultural, and urban lands, having water quality characteristics associated with land cover and use. Undeveloped, forested areas in the northern basin contain aquatic communities associated with excellent water quality, while agricultural and urban areas have streams with water chemistry reflecting anthropogenic sources, including regional farming practices, treated and untreated sanitary inflows, and stormwater runoff. Increasing development in the watershed of study area tributaries has led to changes in stream discharge and/or water quality (Brown et al. 2010; Wu and Xu 2007; Turner et al. 2002; Patil and Deng 2008).

Chemical transformations occurring in the estuary can be biologically mediated by estuary wetlands. Wetlands have the ability to remove constituents such as nutrients, suspended sediments, organic matter, and metals from the water column, but can also serve as a source for these constituents, depending on factors such as duration of exposure to chemical loadings, wetland type, and hydrologic conditions (Mitsch and Gosselink 2000). Louisiana wetlands are not uniform in their ability to assimilate constituents (Rabalais et al. 1995).

A diversity of wetland types exist within the estuary, and are distributed based on surface water salinity as well as historical and current ground elevations. These wetlands are affected by marine and geological processes such as tidal variation, subsidence, and marine reworking of sediments (Gosselink 1984). Recently, anthropogenic factors are believed to have led to accelerated deterioration of estuary wetlands. In the study area, subsidence and impoundment has led to excessive flooding in the Maurepas Swamp, which prevents seed germination and recruitment of primary overstory tree species (Baldcypress and Water Tupelo), and can lead to tree stress and mortality (Keddy et al. 2007).

Regional and continental weather can also influence estuary water quality. For example, variations in precipitation, temperature, and wind direction can affect level of estuary marine influence, flow direction, water level, and wetlands biogeochemistry (Gosselink 1984). The estuary is periodically affected by tropical activity and the diversion of Mississippi River flood waters, which can lead to the influx of large volumes of salt- and/or freshwater. Recently, major hurricanes have affected the area approximately once every three years (in 2005, 2008, and 2011), while the influx of Mississippi River water through the Bonnet Carré Spillway for flood relief occurred in 1997, 2008, and 2011. Timing and amount of precipitation can also affect water quality. For example, Demcheck et al. (2004) found that pesticide and nutrient concentrations in Louisiana streams can vary seasonally based on timing of fertilizer and pesticide application. In the study area, a drought form spring 1999 to summer 2001 is believed to have contributed to an increased mortality rate of forested wetland tree species (Keddy et al. 2007).

1.2 Methods, Criteria, and Guidelines for Evaluation of Sediment and Water Quality

1.2.1 Water Quality

1.2.1.1 Louisiana Water Quality Inventory

The Clean Water Act (CWA) established a process for states to develop information on the quality of their water resources. Section 305(b) requires that each state develop a program to monitor the quality of its surface and groundwater, and prepare a report describing the status of its water quality. Section 303(d) requires states to list impaired waterbodies where water quality standards are not met and designated uses are not fully supported, and to develop a Total Maximum Daily Load (TMDL) for those waterbodies. The *Louisiana Water Quality Inventory Report: Integrated Report* (LDEQ 2013), prepared by the Louisiana Department of Environmental Quality (LDEQ), is the current form of biennial reporting of the status of Louisiana waters in accordance with CWA sections 305(b) and 303(d).

For the purpose of water quality monitoring and assessment and development of TMDLs, Louisiana is divided into twelve major basins, and each basin is further divided into subsegments. This subsegment approach divides the State's waters into discrete hydrologic units. The subsegment system within each basin provides a framework for evaluating state waters. Subsegments are periodically added or removed as water quality standards related to a subsegment or group of subsegments are revised.

Section 305(b) of the Clean Water Act requires, among other items, a water quality assessment for each subsegment, which includes a description of each subsegment and the extent to which their waters provide for the protection and propagation of fish and wildlife and allow for recreational activities in and on the water (USEPA 2011). All assessments are prepared using existing and readily available water quality data and information in order to comply with rules and regulations under Section 305(b) of the Clean Water Act.

Subsequently, Section 303(d) of the Clean Water Act requires the identification, listing, and ranking for development of Total Maximum Daily Loads (TMDLs) for waters that do not meet applicable water quality standards after implementation of technology-based controls. By definition, a TMDL is the maximum amountof a pollutant that can be discharged into a water body from all sources (both point and non-point) and still maintain water quality standards.

Louisiana Water Quality Standards (*LAC 33:IX.1123*) define eight designated uses for surface waters, including: primary contact recreation; secondary contact recreation; fish and wildlife propagation; drinking water supply; oyster propagation; agriculture; outstanding natural resource; and limited aquatic life and wildlife use. Principal designated uses for Louisiana waterbodies include primary contact recreation, secondary contact recreation, and fish and wildlife propagation. The definitions for these primary uses are:

- *Primary Contact Recreation*—any recreational or other water contact activity involving prolonged or regular full-body contact with the water and in which the probability of ingesting appreciable amounts of water is considerable. Examples of this type of water use include swimming, skiing, and diving.

- *Secondary Contact Recreation*—any recreational or other water contact activity in which prolonged or regular full-body contact with the water is either incidental or accidental, and the probability of ingesting appreciable amounts of water is minimal. Examples of this type of water use include fishing, wading, and boating.
- *Fish and Wildlife Propagation*—the use of water for aquatic habitat, food, resting, reproduction, cover, and/or travel corridors for any indigenous wildlife and aquatic life species associated with the aquatic environment. This use also includes the maintenance of water quality at a level that prevents damage to indigenous wildlife and aquatic life species associated with the aquatic environment and contamination of aquatic biota consumed by humans. The use subcategory of *limited aquatic life and wildlife* recognizes the natural variability of aquatic habitats, community requirements, and local environmental conditions. *Limited aquatic life and wildlife* use may be designated for water bodies having habitat that is uniform in structure and morphology, with most of the regionally expected aquatic species absent, low species diversity and richness, and/or a severely imbalanced trophic structure. Aquatic life able to survive and/or propagate in such water bodies includes species tolerant of severe or variable environmental conditions. Water bodies that might qualify for the *limited aquatic life and wildlife* use subcategory include intermittent streams, and naturally dystrophic and man-made water bodies with characteristics including, but not limited to, irreversible hydrologic modification, anthropogenically and irreversibly degraded water quality, uniform channel morphology, lack of channel structure, uniform substrate, lack of riparian structure, and similar characteristics making the available habitat for aquatic life and wildlife suboptimal.

Designated uses and criteria for each subsegment are listed in the Louisiana Water Quality Standards. Designated uses have a specific suite of ambient water quality parameters used to assess their support. Data and information collected from within or immediately downstream of a subsegment are used to evaluate each subsegment's designated uses. Where more than one parameter and criterion define a designated use, support for each use is defined by the designated use's poorest performing (most severely impaired) parameter. Likewise, where data from more than one sample station are available, the most severely impaired station is used to make the assessment.

Following statistical determination of a water body's designated use support, along with a determination of the chemical parameters in the subsegment which might be impaired, a determination is then made as to which Integrated Report Category (IRC) the suspected water body impairment combination (WIC) should be placed in. A WIC is a single impairment affecting one subsegment. Based on the IR Category, it is possible that either a TMDL is required, or has been completed, for a particular subsegment.

In addition to use of numerical data, LDEQ regional staff members are asked for input regarding significant suspected sources of impairment, or whether impairment due solely to natural sources is occurring. Numerical data alone can suggest impairment for some Louisiana water bodies when in fact there is no impairment or the impairment is due exclusively to natural causes. Using best professional judgment, regional staff members familiar with the area suggest one or more suspected source for a subsegment's impairment.

Total maximum daily loads (TMDLs) indicate that the majority of the pollutant load entering state waters comes from nonpoint sources of pollution; therefore, LDEQ is implementing a watershed-based approach to reducing those loads in the water bodies where TMDLs have been completed. Presently, LDEQ utilizes both regulatory and non-regulatory mechanisms to control nonpoint sources of pollution. Urban storm water for cities with populations of 50,000 or greater and construction sites of one acre or more are regulated through the Louisiana Pollutant Discharge Elimination System (LPDES) permit program. Home sewage treatment systems are regulated through the LDHH. LDEQ's Water Quality Assessment Division (WQAD) currently houses the state's Nonpoint Source Management Program, which has been successful in implementing voluntary programs for forestry and agricultural sources of pollution. This has been done through coordination with other concerned agencies, such as the Louisiana Department of Agriculture and Forestry (LDAF), the U.S. Natural Resource Conservation Service (NRCS), and the Louisiana State University (LSU) AgCenter. LDEQ will continue to monitor state waters through the four-year cyclic process to determine whether the current implementation strategy is successful in restoring and maintaining water quality and the designated uses within Louisiana.

1.2.1.2 Louisiana Pollutant Discharge Elimination System (LPDES)

Louisiana's water quality regulations require permits for the discharge of pollutants from any point source into waters of the state of Louisiana. This surface water discharge permitting system is administered under the Louisiana Pollutant Discharge Elimination System (LPDES) program.

LPDES permits are official authorization developed and promulgated by the Office of Environmental Services of LDEQ. The LPDES permit establishes the wasteload content of wastewaters discharged into waters of the state. The permitting process allows the state to control the amounts and types of wastewaters discharged into its surface waters, in order to meet water quality standards. In 1996, LDEQ assumed responsibility for administering the permitting, compliance, and enforcement activities of the National Pollutant Discharge Elimination System (NPDES) from the U.S. Environmental Protection Agency (USEPA).

1.2.1.3 Louisiana Nonpoint Source Management Plan

Nonpoint source pollution is a type of pollution which is generated during rainfall events, and includes, among other things, agricultural and urban runoff. Section 319 of the Clean Water Act requires that states develop a nonpoint source management plan to reduce and control nonpoint sources of pollution from the various types of land uses that contribute to water quality problems across the United States. Louisiana has determined that agriculture, forestry, urban runoff, home sewage systems, sand and gravel mining, construction, and hydromodification all contribute to nonpoint source pollution problems across the state. Nonpoint source pollution is the largest remaining type of water pollution that needs to be addressed within Louisiana, and across the nation, in order to restore full support for designated uses of impaired waterbodies.

Louisiana's Nonpoint Source Program is managed by the LDEQ, and the goal of the program is to provide education regarding nonpoint source pollution and nonpoint source pollution prevention. The state of Louisiana has applied for and received Section 319 funds to implement both statewide and watershed projects to address nonpoint source pollution.

1.2.1.4 Water Quality Criteria

Water quality criteria are elements of state water quality standards expressed as constituent concentrations, levels, or narrative statements representing the quality of water supporting a particular designated use. When criteria are met, water quality will protect the designated use. Louisiana has both general and numeric criteria in *LAC 33:IX.1113*. General criteria are expressed in a narrative form and include aesthetics, color, suspended solids, taste and odor, toxic substances (in general), oil and grease, foam, nutrients, turbidity, flow, radioactive materials, and biological and aquatic community integrity. Numeric criteria are generally expressed as concentrations or scientific units and include pH, chlorides, sulfates, total dissolved solids, dissolved oxygen, temperature, bacteria, and specific toxic substances.

The USEPA has published national criteria recommendations for a number of substances, and states may incorporate these without modifications into their water quality standards. However, while states generally use USEPA guidance and recommendations in developing and adopting their own criteria, they are allowed the flexibility to develop their own methodology as well. USEPA guidance is under continuous development and revision. States review and incorporate these developments and revisions into their water quality standards as appropriate.

Aquatic life criteria are designed to protect all aquatic life, including plants and animals, and include two types of criteria: acute, for short-term exposures (e.g., spills); and chronic for long-term or permanent exposures. One or both of the acute and chronic criteria may be related to other water quality characteristics, such as pH, temperature, or hardness. Separate criteria are developed for fresh and salt waters. The federal water quality standards regulations allow states to develop numerical criteria or modify USEPA's recommended criteria to account for site-specific or other scientifically defensible factors.

Human health criteria provide guidelines that specify the potential risk of adverse effects to humans due to substances in the water. Factors considered include body weight, risk level, fish consumption, drinking water intake, and incidental ingestion while swimming. Categories of criteria are then developed for each toxic substance for public drinking water supply, non-drinking water (swimming), and non-swimming water.

1.3 Study Area Historical and Existing Water Quality

1.3.1 Literature Review

Increasing development within the Pontchartrain basin with minimal regard for maintaining environmental quality during most of the twentieth century is cited as the primary cause of historical degradation of estuary waters (Hastings 2009). Associated pollution sources include sewage discharges into estuary tributaries, increased urbanization and farming, mining of waterbottoms, and oil and gas activities. While in recent decades many of these sources (particularly sewage discharges, shell dredging in Lakes Maurepas and Pontchartrain, oil and gas exploration) have been curtailed, urbanization and farming continue, and in some areas is increasing (Patil and Deng 2008, Brown et al. 2010, Turner et al. 2002, Wu and Xu 2007).

Historical study area water quality is depicted in several references which include the review of data from basin tributaries and estuary lakes and passes. Garrison (1999) provides a summary of general parameters, major ions, nutrients, trace metals, and organic compounds for water quality data collected in Lake Maurepas between 1943 and 1995 (detected parameters are summarized in Table 1.1). Overall, the summary suggests the lake has historically been freshwater and oligotrophic, with generally low contaminant levels.

Table 1.1. Lake Maurepas historical water quality summary (source: Garrison[1999])

Group	Parameter	Units	Lake Maurepas, in Middle			Pass Manchac at Lake Maurepas		
			Percentile			Percentile		
			25th	50th (Median)	75th	25th	50th (Median)	75th
Physical properties	Specific Conductance	µmhos/cm	159	281	684	2120	2550	3700
	pH	SU	7	7.2	7.3	6.5	6.6	6.8
	Water Temperature	°C	16.8	21.5	26.5			
	Dissolved Oxygen	mg/L	7.2	7.8	9.1			
	Dissolved Solids	mg/L				1230	1470	2150
Major cations	Calcium (Dissolved)	mg/L	5.9	7.2	11	20	24	38
	Magnesium (Dissolved)	mg/L	3.6	5.8	13	36	46	72
	Sodium (Dissolved)	mg/L	17	25	52	320	410	590
	Potassium (Dissolved)	mg/L	2.5	3.1	4.7	11	15	30
Major Anions	Alkalinity, Total as CaCO3	mg/L	18	21	25			
	Sulfate (Dissolved)	mg/L	10	17	32	89	120	150
	Chloride (Dissolved)	mg/L	29	60	180	580	720	1100
Nutrients	Nitrate + Nitrite, Total as Nitrogen	mg/L	0.09	0.18	0.31			
	Phosphorus, Total as Phosphorus	mg/L	0.09	0.11	0.14			
Trace Metals	Copper (Dissolved)	µg/L	<2	2	4			
	Iron (Dissolved)	µg/L	50	140	230			
Organic Compounds	2,4-D (Total)	µg/L	0.03	0.04	0.06			

Sikora and Kjerve (1985) and Tate et al (2002) both reviewed pre- and post-MRGO salinity trends in the Pontchartrain estuary, with the monitoring site closest to the study area included in the review located on the western end of Pass Manchac. Findings suggest average salinities in Pass Manchac increased by 0.2-0.4 PPT post-MRGO. Sikora and Kjerve (1985) suggested that increased salinities were likely the result of short-lived influxes of high-salinity water. Both of these studies utilized data from prior to the 1999-2001 drought suspected of contributing to elevated salinities in the study area.

Patil and Deng (2008) investigated water quality and sediment load of the Amite River, the largest tributary of the Pontchartrain estuary, located on the northern border of the study area just west of Lake Maurepas. Median dissolved oxygen concentration in the lower Amite River decreased by 1 mg/L when comparing 1975-1990 and 1991-2005 monitoring data (6.8 mg/L vs. 5.7 mg/L), despite decreased median nutrient (nitrate plus nitrite, total phosphorus) concentrations between the same time periods, which was attributed to discontinued use of phosphate detergents and adoption of best management practices for agriculture and forestry in the watershed. Median total organic carbon and total suspended solids increased between time periods, suggesting factors other than nutrient enrichment, such as continued sand and gravel mining in the upper Amite River, and increased urbanization of the greater Baton Rouge area, may be responsible for the reduction in dissolved oxygen concentrations. Recently, a TMDL for organic enrichment and low dissolved oxygen levels was developed for this the Lower Amite River subsegment, with the associated report suggesting that increased conveyance in the Amite River diversion canal is contributing to reduced water velocities (and, therefore, increasing stagnation) in the lower river, which has served to concurrently reduce dissolved oxygen concentrations (LDEQ 2011).

Several studies within the study area were conducted in support of the diversion of Mississippi River water into the Maurepas Swamps (e.g., Lee Wilson and Associates 2001, Shaffer et al. 2003, Hoeppner et al. 2008, Lane et al. 2003, Shaffer et al. 2009), and include some discussion of study area water quality. Lane et al. (2003) provides a summary of water quality for surface water samples collected monthly from April to October 2000 (during the 1999-2001 drought in southern Louisiana) in the Blind River, Hope Canal, Dutch Bayou, Reserve Canal, and Lake Maurepas. Ranges of averages for measured parameters are as follows: nitrate plus nitrite – 0-

0.5 mg/L, total nitrogen – 0.35-0.9 mg/L, ammonium – 0-0.03 mg/L, chlorophyll a – 2-21 µg/L, phosphate – 0.015-0.95 mg/L, total phosphorus – 0.03-0.13 mg/L, total suspended solids – 9-44 mg/L, salinity – 2.2-9 PPT. Because of drought conditions during the sampling period, the data included in the study may not be representative of general water quality conditions in the study area. The remaining studies referenced include descriptions of the condition of swamp habitat as it relates to water quality. In general, studies show correlation between elevated salinities in the swamps surrounding Lake Maurepas and high rates of tree mortality in the years following the 1999-2001 drought, as well as increased plant production with combined nutrient addition and herbivory control. These studies primarily suggest that river water diversions during droughts may prevent some areas around the lake from experiencing high mortality rates of primary overstory tree species during times of elevated surface water salinities, and that increasing nutrient inputs (e.g., with diversions) while controlling for herbivory on a watershed scale may lead to increased swamp aboveground productivity.

1.3.2 Louisiana Water Quality Inventory

To provide a general assessment of study area historical water quality, a review of historical water quality inventories for subsegments within the study area was conducted. Table 1.2 and Figure 1.2 depict all subsegments included in the study area.

Table 1.2. Study area subsegments

Subsegment	Subsegment Description	Type	Size
040401	Blind River-Amite River Diversion canal to mouth at Lake Maurepas (Scenic)	River	5
040403	Blind River-Source to confluence with Amite River Diversion Canal (Scenic)	River	20
040404	New River-Headwaters to New River Canal	River	24
040601	Pass Manchac-Lake Maurepas to Lake Pontchartrain	River	7
040602	Lake Maurepas	Estuary	91
041001	Lake Pontchartrain-West of La. Hwy. 11 Bridge (Estuarine)	Estuary	559

Clean Water Act Section 305(b) assessments of study area subsegments, for each reporting period between 1998 and 2010, were included in the review. For each subsegment, an average designated use support value was calculated. The calculated average support values were a function of designated use and level of support. Support levels for each combination of subsegment, year, and designated use were as follows:

0: subsegment not supporting designated use
1: subsegment fully supporting designated use

The average support value calculated for each subsegment serves as a simplistic representation for subsegment health with respect to designated uses (with zero being the least healthy value possible, and one being the most). In order to develop a visual representation of the long-term health of each subsegment with respect to designated uses, the average support values for subsegments were color-coded, with breakpoints of 0.5 and 0.75. Table 1.3 and Figure 1.2 illustrates the average support values for each subsegment.

Table 1.3. Subsegment average support values, 1998-2012

Subsegment	Average of Support, 1998-2010
040401	0.46
040403	0.50
040404	0.17
040601	0.88
040602	0.45
041001	0.74

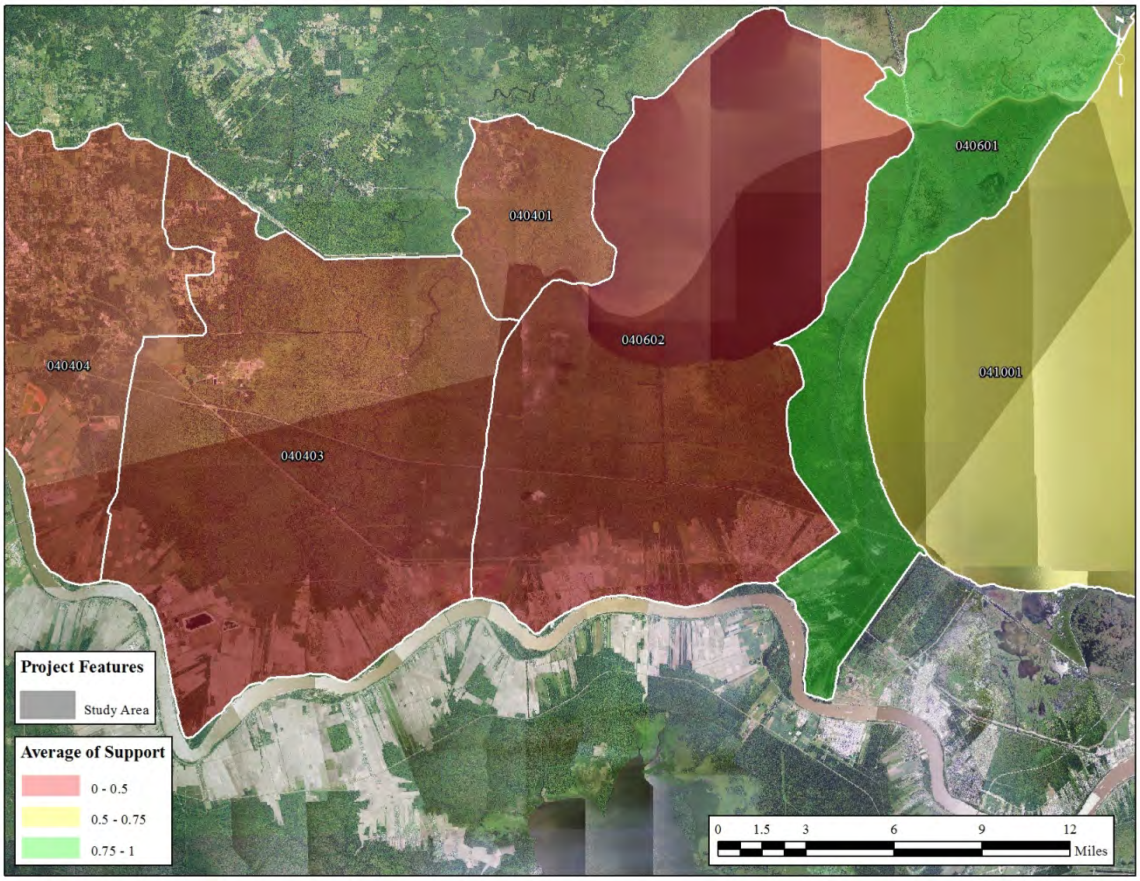


Figure 1.2. Map of study area subsegments and subsegment average support values

Long-term average support values reveal that impairments are commonplace in subsegments west of the Maurepas landbridge, and less common eastward.

To determine the most prevalent water quality issues present in the study area, historical Section 305(b) assessments were reviewed to determine the most significant causes and sources of subsegment impairment (Appendix Tables A.1 and A.2). Between 1998 and 2010, the most commonly suspected causes were non-native aquatic plants, low dissolved oxygen, mercury, fecal coliform, total phosphorus, sedimentation/siltation, and elevated turbidity, while the most commonly suspected sources were unknown sources, atmospheric deposition, introduction of non-native organisms, on-site treatment systems, wetland habitat modification, and site clearance for land development/redevelopment.

The most current (2012) 303(d) list for the study area is depicted in Table 1.4. Ordered by decreasing frequency cited, suspected causes of impairment include non-native aquatic plants, low dissolved oxygen, mercury, elevated turbidity, and fecal coliform, while suspected sources of impairment include wetland habitat modification, introduction of non-native organisms, atmospheric deposition, unknown sources, on-site treatment systems, natural sources, and agriculture.

Table 1.4. Study area 2012 303(d) list

Subsegment	Impaired Use for Suspected Cause	Suspected Cause of Impairment	Suspected Source of Impairment	IR Category	TMDL Priority
040401	FWP	Dissolved Oxygen	Wetland Habitat Modification	IRC 5	L
		Mercury	Atmospheric Deposition	IRC 4a	
			Source Unknown	IRC 4a	
		Non-Native Aquatic Plants	Introduction of Non-native Organisms	IRC 4b	
		Turbidity	Wetland Habitat Modification	IRC 4a	
	ONR	Turbidity	Wetland Habitat Modification	IRC 4a	
	PCR	Water Temperature	Natural Sources	IRC 5	L
			Wetland Habitat Modification	IRC 5	L
040403	FWP	Dissolved Oxygen	Agriculture	IRC 5	L
			Wetland Habitat Modification	IRC 5	L
		Mercury	Atmospheric Deposition	IRC 4a	
				IRC 5	L
			Source Unknown	IRC 4a	
				IRC 5	L
		Non-Native Aquatic Plants	Introduction of Non-native Organisms	IRC 4b	
040404	FWP	Dissolved Oxygen	On-site Treatment Systems	IRC 5	L
		Non-Native Aquatic Plants	Introduction of Non-native Organisms	IRC 4b	
	PCR	Fecal Coliform	On-site Treatment Systems	IRC 5	H
040602	FWP	Non-Native Aquatic Plants	Introduction of Non-native Organisms	IRC 4b	

Both historical 305(b) assessments and current 303(d) lists suggest primary study area water quality problems relate to hypoxia. As a further to this suggestion, as mentioned earlier, in 2011 a TMDL report was prepared for the lower Amite River watershed (located just north of subsegments partially included in the study area) to address organic enrichment and low dissolved oxygen.

1.3.3 LPDES Permitted Discharges

Figure 1.3 depicts locations of point source discharges permitted under the LPDES. There are a total of 123 LPDES permitted discharges in the study area, nearly all of which are located along the Mississippi River corridor. It is likely that most of these permitted discharges occur in the Mississippi River, which is currently only connected to the study area (its easternmost extent) when the Bonnet Carré Spillway is opened during flood stages on the river. There are a total of 26 toxic release inventory (TRI) permitted discharges in the study area, most (except for two) are also LPDES permitted discharges. Again, it is likely most of these permitted discharges go into the Mississippi River. Permitted discharges more relevant to the study are more likely to occur in major tributaries of the Pontchartrain Basin that feed into Lake Maurepas, such as the Amite and Rivers.

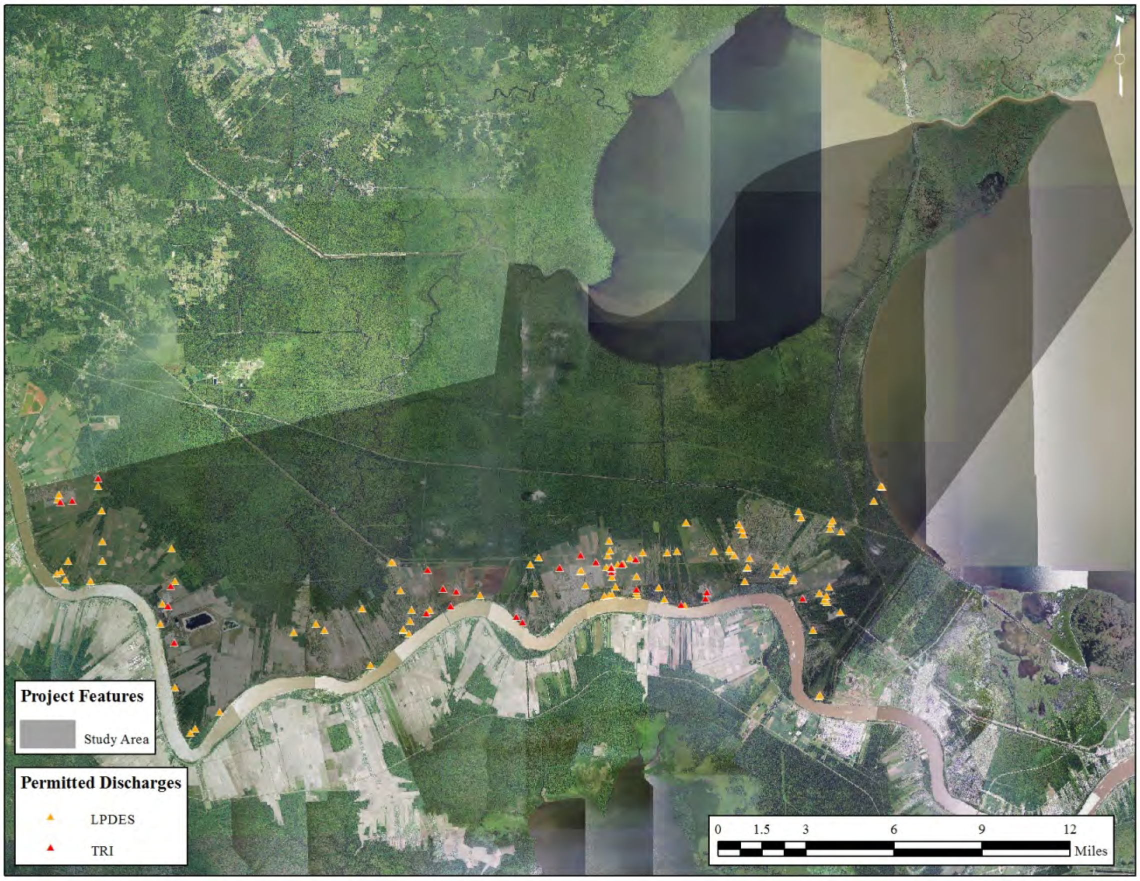


Figure 1.3. Study area LPDES permitted discharges

1.3.4 Water Quality Monitoring

1.3.4.1 Introduction

Long-term water quality monitoring in the study area has been conducted by the Louisiana Department of Environmental Quality (LDEQ). Table 1.5 and Figure 1.4 depict monitoring station locations and monitoring time periods, while Appendix Table A.3 includes monitoring metadata for each station.

Table 1.5. Long-term water quality monitoring station information

Station ID	Station Description	Subsegment	Latitude	Longitude	Monitoring Period	
					Begin	End
36	Pass Manchac at Manchac, Louisiana	040601	30.281389	-90.400278	1978	2011
117	Blind River near Gramercy, Louisiana	040403	30.100000	-90.735278	1978	1998
155	Mississippi Bayou north of Reserve, Louisiana	040602	30.123889	-90.582500	1991	1998
1102	Blind River near confluence with Lake Maurepas	040401	30.217222	-90.599444	2001	2010

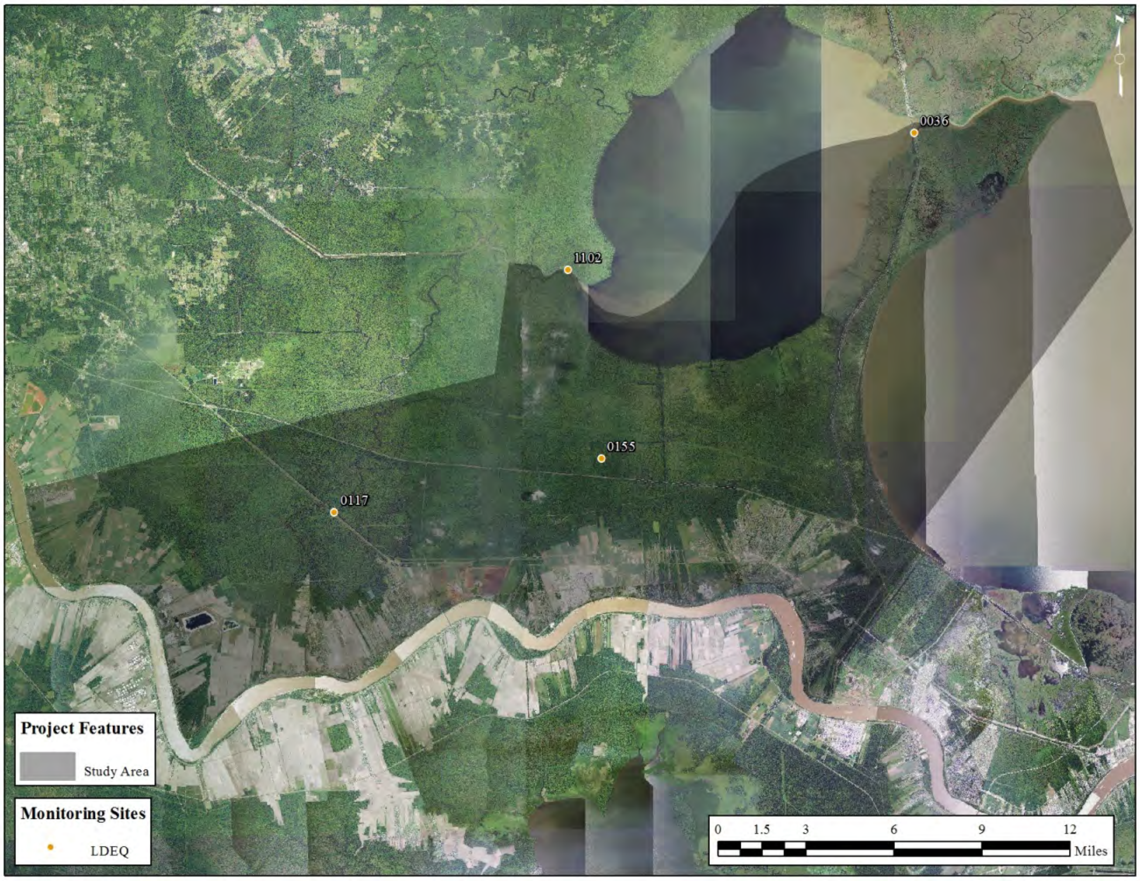


Figure 1.4. Study area long-term water quality monitoring station locations

1.3.4.2 <u>Summary of Water Quality Monitoring Data</u>

Monitoring parameters selected for data summary are listed in Table 1.6; more detailed information concerning these parameters is available in Appendix Table A.4. Parameters were selected for summary based on the need for a general depiction of study area water quality (i.e., conventional parameters), frequency of citation as a suspected cause of impairment in the study area, water quality concerns in the study area highlighted in available literature discussed elsewhere in this assessment, and robustness of dataset.

Table 1.6 – Monitoring parameters selected for data summary

Chemical Class	Parameter
Inorganic/General Chemistry	Alkalinity
	Carbon, Total Organic
	Chloride, Ion Chromatograph
	Conductivity
	Dissolved Oxygen
	Dissolved Oxygen, Percent Saturation
	Dissolved Solids, Total
	Nitrogen, Nitrate + Nitrite
	Oxygen Demand, Chemical
	pH
	Turbidity
Metals	Nickel
N/A	Fecal Coliform
	Suspended Solids, Total

For each long-term monitoring station in the study area, data was summarized by means of boxplots (overall and seasonal), quantile plots, and trend analysis (Appendix Figures A.1-A.42). Data summary in the final water quality assessment will include nonparametric trend analysis, which may be more appropriate for the skewed (not normally distributed) data included in the monitoring dataset.

Overall boxplots (Appendix Figures A.1-A.14) reveal the differences between the monitoring stations based on salinity gradient and habitat. For example, stations 117 and 155, located in the Maurepas swamps, generally contain higher alkalinity, fecal coliform, and dissolved nickel, and lower dissolved oxygen, while station 36 contains elevated chloride, conductivity, and total dissolved solids relative to all other stations. The most notable characteristics of the boxplots were the high alkalinity and low dissolved oxygen at swamp sites, along with the high chloride and conductivity concentrations for the Pass Manchac station relative to other stations. For stations 117 and 155, the lower and upper quartiles of dissolved oxygen concentrations were below the state water quality criteria for freshwater of 5 mg/L.

Seasonal boxplots (Appendix Figures A.15-A.28) reveal trends for several parameters. Highest alkalinity values for stations 117 and 155 occur in summer, while highest total organic carbon concentrations for these stations follow in the fall. For dissolved oxygen, at all sites summer concentrations were lowest, while winter concentrations were highest. Chloride, conductivity, and total dissolved solids follow similar seasonal patterns at all sites, which includes generally increasing concentrations from winter to fall (winter<spring<summer<fall). For stations 117 and 155 and all seasons except winter, and station 1102 in summer, both the lower and upper quartiles of dissolved oxygen concentrations were below the state water quality criteria for freshwater of 5 mg/L.

In general, quantile plots (Appendix Figures A.28-A.42) for all parameters and stations have high correlation coefficients (note: for some parameters, data was log transformed to improve correlation coefficients). Of the 45 regression curves, 45 had a correlation coefficient greater than 0.9, and 32 had a coefficient greater than 0.95. Particularly for parameters where a large proportion of the data was below reporting limits (e.g., Fecal Coliform, nitrate plus nitrite, nickel), correlation coefficients were low, and data was skewed, suggesting nonparametric methods of trend analysis (e.g., Kendall's Tau) may be more appropriate.

Trend analysis using linear regression may be most meaningful for parameters with a normal data distribution and longer/larger data record (including alkalinity, total organic carbon, chloride, chondictivity, dissolved oxygen, total dissolved solids, turbidity, and total suspended solids, for stations 36 and 117). Several parameters, including alkalinity, chloride, pH, turbidity, and total suspended solids, suggest decadal-scale cycling of water quality. Overall, correlation coefficients were very low (less than 0.05) for the larger data record stations, with the exception of alkalinity (0.0563, negative regression slope) and chloride (0.056, positive regression slope) for station 36, suggesting increasing marine influence in the Pass Manchac area between 1978 and 2011.

2.0 Environmental Consequences

2.1 <u>No Action Alternative (Future without Project Conditions)</u>

Direct Impacts: There would be no direct impacts from implementing the No Action Alternative.

Indirect Impacts: Water quality trends in the study area are expected to continue without the proposed project. In particular, existing dissolved oxygen trends, as well as existing trends in salinity gradients, would be expected to continue. Additionally, without the proposed project, there would be an increased risk of flooding of the Mississippi River corridor in the study area, and drainage of floodwaters into waterbodies connected to the Maurepas Swamp and Lake Maurepas is a possibility. If this were to occur, a large volume of diluted urban runoff characterized by elevated nutrients, metals, and organics could be introduced into the Maurepas Swamps and Lake Maurepas, similar to the introduction of urban floodwaters from New Orleans into Lake Pontchartrain following Hurricanes Katrina and Rita in 2005 (Farris et al. 2007) .

Without the proposed project, study area would still be affected by the following:
Restoration Efforts. In particular, several Mississippi River diversion projects described and referred to in Paragraph 2.2.1 of the Report as the LCA Convent Blind River and the Maurepas Swamp Diversion projects. These projects have the potential to locally reduce salinity stress and temporarily improve dissolved oxygen levels; however, concurrently they have the potential to generate significant changes in wetlands biogeochemistry, some of which may negatively affect wetland plant community resiliency (e.g., see Swarzenski et. al 2005). Additionally, the recent MRGO closure may influence study area water quality by reducing slightly area salinities during salinity intrusion events (e.g., during a drought).

Federal and state water quality management programs. Programs such as those described in this assessment would continue under the pretext of improving water quality and reducing the frequency of impairment of study area waterbodies. Programs to address land use practices in the Mississippi River watershed and associated river water quality impacts may be particularly important in determining study area water quality, because of the multiple Mississippi River diversion projects that would affect the study area (Broussard 2008).

Coastal deltaic processes. The study area would continue to be impacted by coastal deltaic processes associated with a transgressive delta, such as subsidence, erosion, and habitat conversion. The Maurepas Swamp area is anticipated to continue in its decline while converting to marsh and open water, in turn affecting local water quality conditions.

Development. Including oil and gas development within the study area; the continued increasing development of the Amite River watershed and other watersheds which influence study area water quality; existing and future Federal, state, and municipal flood-damage reduction projects; and continued agricultural and forestry activities and associated management practices. The trend of decreasing dissolved oxygen in the lower Amite River, which has been linked to development in the watershed, mining of waterbottoms within the river, and hydromodification in the lower river, is expected to continue.

Climate. Future changes in atmospheric temperature are anticipated to impact sea-level, and may also impact frequencies of tropical activity (Mousavi et. al 2011), with anticipated impacts to water quality (e.g., increased frequency of salinity intrusion events).

Cumulative Impacts: Cumulative impacts would be the incremental direct and indirect impacts described above of not implementing and operating the proposed hurricane and flood risk reduction system in addition to the direct and indirect impacts to water quality and salinity attributable to other hurricane and flood risk reduction systems which have not and would not be implemented within the Pontchartrain Basin, Louisiana, and the Nation (see Section 4.1.1 Soils and Water bottoms Alternative C (TSP) Cumulative Impacts).

2.2 Future with Project Conditions

2.2.1 Alternative C

Direct Impacts: The proposed project entails construction of approximately 21 miles of levee, some of which includes wetlands and open water, and would directly impact the area within the proposed footprint which currently consists of wetlands and open water. These areas would be converted into upland habitat, and would no longer provide for surface water quality. As coastal wetlands are known to benefit water quality, for example, as a source or sink for constituents, these benefits would no longer exist within the proposed levee footprint.

Direct impacts to water quality associated with the proposed alternative would also be related to construction activities, including the placement of fill and construction materials for project construction, and runoff from construction areas. Because fill material and construction materials are anticipated to be free of contaminants, discharge of these materials into existing adjacent surface waters and wetlands is not anticipated to lead to significant adverse effects on aquatic organisms present at the construction sites.

Construction activities are expected to result in localized increases in turbidity associated with runoff of construction materials. To minimize construction-related impacts, a Stormwater Pollution Prevention Plan (SWPPP) will be implemented for construction activities. SWPPPs will be prepared in accordance with good engineering practices emphasizing storm water Best Management Practices and complying with Best Available Technology Economically Achievable and Best Conventional Pollutant Control Technology. The SWPPP will identify potential sources of pollution which may reasonably be expected to affect storm water discharges associated with the construction activity. In addition, the SWPPP will describe and ensure the implementation of practices which are to be used to reduce pollutants in storm water discharges associated with the construction activity and to assure compliance with the terms and conditions of this permit (USEPA 2012).

Indirect Impacts: The proposed hurricane protection project would indirectly impact study area water quality. Although environmental water control structures are being incorporated into project design to minimize changes in flow and water level between the flood and protected side of the proposed levee alignment , and although the proposed alignment largely follows existing hydrologic features, water exchange between the flood and protected side may be modified, leading to localized areas of stagnation and reduced salinities behind the levee alignment, along with local areas of increased salinity on the flood side of the alignment. Moreover, the potential expansion of development in the area could lead to additional point and nonpoint discharges within the hurricane and storm damage risk reduction system, which would further degrade water quality on the protected side of the proposed alignment. Also, as sea-level rise increases water levels in the study area, the frequency with which environmental water control structures are closed would be expected to increase, causing further stagnation for waters on the protected side of the proposed levee alignment.

Hydrology plays a major role in biogeochemical cycling in wetlands (Mitsch and Gosselink 2000), which in turn can affect water quality. Operation of these structures is expected to have a significant impact on biogeochemical cycling for wetlands in the study area, particularly on the protected side of the proposed levee alignment. This could be beneficial or detrimental, depending on the operation of gates and tidal exchange structures and impediment of flow caused by the proposed project.

A major potential benefit of the project is that it would provide for the protection of wetlands enclosed by the proposed levee alignment, potentially extending the lifespan of these wetlands and their water quality functions. However, the wetlands just outside of the proposed levee alignment are expected to be subjected to an increase in wave energy and salinity as a result of the proposed project, particularly during tropical activity in the study area, which could ultimately lead to the accelerated loss of unprotected wetlands.

The proposed project, combined with other coastal activities (such as those included in the discussion of future without project conditions), would cumulatively impact study area water quality, both beneficially and detrimentally. For example, it is foreseeable that the proposed project may impact the attainment of state water quality standards in the study area, leading to changes in regulation of point and nonpoint source discharges within the area, particularly on the protected side of the proposed alignment. This is an issue that needs to be addressed by MVN and LDEQ, so as to avoid impacting the attainment of State water quality standards in the future.

Additionally, the combination of the proposed project, the LCA CBRD project and the Maurepas Swamp Diversion projects in the study area could complicate water quality and hydrology, particularly for the protected side of the proposed alignment. Both an increase in water input from the Mississippi River and decrease in drainage for the protected side of the proposed alignment could lead to significant impacts to the biogeochemistry of the wetlands of the Maurepas Swamp.

Cumulative Impacts: Cumulative impacts would be the incremental direct and indirect impacts of implementing and operating the proposed hurricane and storm damage risk reduction system described above, in addition to the direct and indirect impacts to on water quality and salinity attributable to other existing and authorized for construction hurricanestorm damagerisk reduction systems and flood risk reduction systems within the Pontchartrain Basin, Louisiana, and the Nation (see Section 4.1.1 Soils and Water bottoms Alternative C (TSP) Cumulative Impacts).

2.2.1 Alternative A

Direct, Indirect, and Cumulative Impacts: Because the alignment of this alternative minimizes the further impoundment of study area wetlands , the water quality impacts under this alternative would be expected to be similar in nature but less than impacts associated with Alternative C.

2.2.1 Alternative D

Direct, Indirect, and Cumulative Impacts: Because this alternative encloses the largest area of wetlands by a significant margin while also having the greatest amount of new levee construction, water quality impacts associated with this alternative would be expected to be similar in nature but greater than impacts associated with Alternative C.

3.0 References

Blum, M.D. and H.H. Roberts. 2012. *The Mississippi Delta Region: Past, Present, and Future*. Annual Review, Earth Planetary Science 2012.40:655-683.

Broussard, W.P. 2008. *A Century of Land Use and Water Quality in Watersheds of the Continental U.S*. MS thesis, Louisiana State University, Baton Rouge, Louisiana. http://etd.lsu.edu/docs/available/etd-07072008-182001/. Last accessed on May 28, 2012.

Brown, K.M., G. George, and W. Daniel. 2010. *Urbanization and a threatened freshwater mussel: evidence from landscape scale studies*. Hydrobiologia 655:189-196.

Demcheck, D.K., R.W. Tollett, S.V. Mize, S.C. Skrobialowski, R.B. Fendick Jr., C.M. Swarzenski, and S. Porter. 2004. *Water Quality in the Acadian-Pontchartrain Drainages, Louisiana and Mississippi, 1999-2001.* U.S. Geological Survey Circular 1232. http://pubs.usgs.gov/circ/2004/1232/. Last accessed on May 22, 2013.

Demcheck, D.K. and C.M. Swarzenski. 2003. *Atrazine in Southern Louisiana Streams, 1998-2000*. U.S. Geological Survey Fact Sheet FS-011-03. http://la.water.usgs.gov/publications/pdfs/FS-011-03.pdf. Last accessed on May 22, 2013.

Farris, G.S., G.J. Smith, M.P. Crane, C.R. Demas, L.L. Robbins, and D.L. Lavoie, eds. 2007. *Science and the storms—the USGS response to the hurricanes of 2005*. U.S. Geological Survey Circular 1306. http://pubs.usgs.gov/circ/1306/. Last accessed on May 28, 2013.

Garrison, C.R. 1999. *Statistical Summary of Surface-Water Quality in Louisiana—Lake Pontchartrain-Lake Maurepas Basin, 1943-95*. Louisiana Department of Transportation and Development Water Resources Technical Report No. 55G. http://la.water.usgs.gov/publications/pdfs/TR55G.pdf. Last accessed on May 22, 2013.

Gosselink, J.G. 1984. *The Ecology of Delta Marshes of Coastal Louisiana: A Community Profile*. U.S. Fish and Wildlife Service Report FWS/OBS-84/09. http://www.nwrc.usgs.gov/techrpt/84-09.pdf. Last accessed on May 22, 2013.

Hastings, RW. 2009. *The Lakes of Pontchartrain: Their History and Environments*. Jackson, MS: University Press of Mississippi. 272 pp.

Hoeppner, S.S., G.P. Shaffer, and T.E. Perkins. 2008. *Through droughts and hurricanes: Tree mortality, forest structure, and biomass production in a coastal swamp targeted for restoration in the Mississippi River Deltaic Plain*. Forest Ecology and Management 256:937-948.

Keddy, P.A., D. Campbell, T. McFalls, G.P. Shaffer, R. Moreau, C. Dranguet, and R. Heleniak. 2007. *The Wetlands of Lakes Pontchartrain and Maurepas: Past, Present and Future.* Environmental Reviews 15:43-77. http://www.drpaulkeddy.com/pdffiles/Keddy%20et%20al.%202007%20--%20Env%20Revs%20--%20Lake%20Ponchartrain%20Wetlands%20review.pdf. Last accessed on May 22, 2013.

Lane, R.R., H.S. Mashriqui, G.P. Kemp, J.W. Day. J.N. Day, and A. Hamilton. 2003. *Potential nitrate removal from a river diversion into a Mississippi delta forested wetland*. Ecological Engineering 20:237-249.

Lee Wilson and Associates, Inc. 2001. *Diversion into the Maurepas Swamps*. Contract No. 68-06-0067, WA No. 5-02. U.S. Environmental Protection Agency, Dallas, TX.

Louisiana Department of Environmental Quality (LDEQ). 2013. *2012 Louisiana Water quality Inventory: Integrated Report*. http://www.deq.louisiana.gov/portal/DIVISIONS/WaterPermits/WaterQualityStandardsAssessment/WaterQualityInventorySection305b/2012IntegratedReport.aspx. Last accessed on May 22, 2013.

McCorquodale, J.A., R.J. Robin, I.Y. Georgiou, and K.A. Haralmpides. 2009. *Salinity, Nutrient, and Sediment Dynamics in the Pontchartrain Estuary.* Journal of Coastal Research 54:71-87.

Mitsch, W.J. and J.G. Gosselink. 2000. *Wetlands, 3rd Ed*. John Wiley & Sons, New York. 920 pp.

Mousavi, M.E., J.L. Irish, A.E. Frey, F. Olivera, and B.L. Edge. *Global warming and hurricanes: the potential impact of hurricane intensification and sea level rise on coastal flooding*. Climate Change 104:575-597.

Patil, A. and Z.Q. Deng. 2008. *Watershed Scale Variation in Water Quality in Lake Pontchartrain Basin*. From American Society of Civil Engineers World Environmental and Water Resources Congress 2008. http://ascelibrary.org/doi/pdf/10.1061/40976%28316%29641. Last accessed on May 22, 2013.

Rabalais, N.N., Q. Dortch, D. Justic, M.B. Kilgen, P.L. Klerks, P.H. Templet, and R. E. Turner. 1995. *Status and Trends of Eutrophication, Pathogen Contamination, and Toxic Substances in the Barataria-Terrebonne Estuarine System*. Barataria-Terrebonne National Estuary Program Publication #22. http://www.btnep.org/BTNEP/resources/downloads/publications.aspx. Last accessed on May 22, 2013.

Shaffer, G.P., W.B. Wood, S.S. Hoeppner, T.E. Perkins, J. Zoller, and D. Kandalepas. 2009. *Degradation of Baldcypress-Water Tupelo Swamp to Marsh and Open Water in Southeastern Louisiana, U.S.A.: An Irreversible Trajectory?* Journal of Coastal Research, Special Issue 54:152-165

Shaffer, G.P., T.E. Perkins, S. Hoeppner, S. Howell, H. Bernard, and A.C. Parsons. 2003. *Ecosystem Health of the Maurepas Swamp: Feasibility and Projected Benefits of a Freshwater Diversion.* Contract No. XX-XX-XXXX. U.S. Environmental Protection Agency, Dallas, TX.

Sikora, W.B. and B. Kjerfve. 1985. *Factors Influencing the Salinity Regime of Lake Pontchartrain, Louisiana, a Shallow Coastal Lagoon: Analsis of a Long-Term Data Set.* Estuaries 8(2A):170-180. http://geotest.tamu.edu/userfiles/167/50.pdf. Last accessed on May 22, 2013.

Swarzenski, C.M., T.W. Doyle, and T.G. Hargis. *Pore-Water and Substrate Quality of the Peat Marshes of the Barataria Preserve, Jean Lafitte National Historical Park and Preserve, and Comparison with Penchant Basin Peat Marshes, South Louisiana, 2000-2002*. USGS Scientific Investigations Report 2005-5121. http://water.usgs.gov/nps_partnership/jela.php. Last accessed on May 22, 2013.

Tate, J.N., A.R. Carrilo, R.C. Bergeer, and B.J. Thibodeaux. 2002. *Salinity Changes in Pontchartrain Basin Estuary, Louisiana, Resulting from Mississipppi River-Gulf Outlet Partial Closure Plans with Width Reduction*. Technical Report ERDC/CHL TR-02-12. Vicksburg, MS: U.S. Army Engineer Research and Development Center. http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA408114. Last accessed on May 22, 2013.

Turner, R.E., Q. Dortch, D. Justic, and E.M. Swenson. 2002. *Nitrogen loading into an urban estuary: Lake Pontchartrain (Louisiana, U.S.A.)*. Hydrobiologia 487:137-152.

U.S. Environmental Protection Agency (USEPA). 2012. *Stormwater Pollution Prevention Plans for Construction Activities*. http://cfpub.epa.gov/npdes/stormwater/swppp.cfm. Last accessed on XXXX.

U.S. Environmental Protection Agency (USEPA). 2011. *Impaired Waters and Total Maximum Daily Loads*. http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/index.cfm. Last accessed on May 22, 2013.

Wu, K and Y.J. Xu. 2007. *Long-term freshwater inflow and sediment discharge into Lake Pontchartrain in Louisiana, USA*. Hydrological Sciences Journal 52(1):166-180.

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

Tables and Figures

List of Figures

List of Tables

Table A.1. Count of suspected causes of impairment, 1998-2012

Suspected Cause of Impairment	Count
Non-Native Aquatic Plants	24
Dissolved Oxygen	21
Mercury	20
Fecal Coliform	12
Total Phosphorus	10
Sedimentation/Siltation	10
Turbidity	9
Copper	7
Pathogen Indicators	6
Metals	5
Flow Alteration	4
Nitrate/Nitrite	4
Chloride	4
Total Dissolved Solids	4
Total Nitrogen	3
Nutrients	2
Sulfates	2
Other Habitat Alterations	2
Pesticides	2
Oil and Grease	2
Water Temperature	1

Table A.2. Count of suspected sources of impairment, 1998-2012

Suspected Source of Impairment	Count
Source Unknown	30
Atmospheric Deposition	18
Introduction of Non-native Organisms	16
On-site Treatment Systems	10
Wetland Habitat Modification	9
Site Clearance for Land Development/Redevelopment	9
Urban Runoff	4
Agriculture	4
Natural Sources	4
Recreational Activities	4
Flow Alteration	3
Groundwater Loadings	3
Land Disposal	2
Petroleum/Natural Gas Activities	2
Industrial Point Source Discharges	2
Municipal Point Source Discharges	2
Animal Feeding Operations	2
Construction	1
Upstream Sources	1

Table A.3. Long-term water quality monitoring parameters

Chemical Class	Parameter	Station ID			
		36	117	155	1102
Inorganic/General Chemistry	Alkalinity	X	X	X	X
	Carbon, Total Organic	X	X	X	X
	Chloride, Ion Chromatograph	X	X	X	X
	Chlorophyll-a				X
	Color	X	X	X	X
	Conductivity	X	X	X	X
	Dissolved Oxygen	X	X	X	X
	Dissolved Oxygen, Percent Saturation	X	X		X
	Dissolved Solids, Total	X	X	X	X
	Hardness, as CaCO3	X	X	X	X
	Nitrogen, Ammonia	X			X
	Nitrogen, Kjeldahl	X	X	X	X
	Nitrogen, Nitrate + Nitrite	X	X	X	X
	Oxygen Demand, Chemical	X	X		
	pH	X	X	X	X
	Phosphorus, Total	X	X	X	X
	Salinity	X	X	X	X
	Sodium	X			X
	Sulfate	X	X	X	X
	Temperature, Water	X	X	X	X
	Turbidity	X	X	X	X
Metals	Arsenic	X	X	X	X
	Cadmium	X	X	X	X
	Chromium	X	X	X	X
	Copper	X	X	X	X
	Lead	X	X	X	X
	Mercury	X	X	X	
	Nickel	X	X	X	X
	Zinc	X			X
N/A	Fecal Coliform	X	X	X	X
	Secchi Depth	X	X	X	X
	Solids, Total Percent of Wet Sample	X	X		
	Stream Depth				X
	Suspended Solids, Total	X	X	X	X
	Total Coliform	X	X		
Semi-Volatile Organic Compounds	Dichlorobenzene, 1,2-	X			X
	Dichlorobenzene, 1,3-	X			X
	Dichlorobenzene, 1,4-	X			X
	Dichloroethene, 1,1-	X	X	X	X
	Trichlorobenzene, 1,2,3-				X
Volatile Organic Compounds	Benzene	X	X	X	X
	Bromoform	X	X	X	X
	Bromomethane	X	X	X	X
	Carbon Tetrachloride	X	X	X	X
	Chlorobenzene	X	X	X	X
	Chlorodibromomethane	X	X	X	X
	Chloroethane	X	X	X	X
	Chloroethyl Vinyl Ether, 2-	X	X	X	
	Chloroform	X	X	X	X
	Chloromethane	X	X	X	X
	Dichlorobromomethane	X	X	X	X
	Dichloroethane, 1,1-	X	X	X	X
	Dichloroethane, 1,2-	X	X	X	X
	Dichloroethylene, trans-1,2-	X	X	X	X
	Dichloropropane, 1,2-	X	X	X	X
	Dichloropropene, cis-1,3-	X	X	X	X
	Dichloropropene, trans-1,3-	X	X	X	X
	Ethylbenzene	X	X	X	X
	Methyl Tertiary Butyl Ether (MTBE)	X			X
	Methylene Chloride	X	X	X	X
	Tetrachloroethane, 1,1,2,2-	X	X	X	X
	Tetrachloroethylene	X	X	X	X
	Toluene	X	X	X	X
	Trichloroethane, 1,1,1-	X	X	X	X
	Trichloroethane, 1,1,2-	X	X	X	X
	Trichloroethylene	X	X	X	X
	Trichlorofluoromethane	X	X	X	X
	Vinyl Chloride	X	X	X	X
	Xylene, o-				X
	Xylenes, m- and p-				X

Table A.4. Long-term water quality monitoring metadata for selected parameters

Chemical Class	Parameter	Station ID 36 n	36 Begin	36 End	117 n	117 Begin	117 End	155 n	155 Begin	155 End	1102 n	1102 Begin	1102 End
Inorganic/General Chemistry	Alkalinity	270	1978	2011	156	1978	1998	45	1991	1998	36	2001	2010
	Carbon, Total Organic	237	1978	2001	174	1978	1998	44	1991	1998	18	2001	2006
	Chloride, Ion Chromatograph	272	1978	2011	179	1978	1998	45	1991	1998	36	2001	2010
	Conductivity	403	1978	2011	258	1978	1998	87	1991	1998	69	2001	2010
	Dissolved Oxygen	275	1978	2011	195	1978	1998	45	1991	1998	37	2001	2010
	Dissolved Oxygen, Percent Saturation	78	1978	2011	120	1978	1989				25	2006	2010
	Dissolved Solids, Total	269	1978	2011	171	1978	1998	45	1991	1998	36	2001	2010
	Nitrogen, Nitrate + Nitrite	276	1978	2011	194	1978	1998	45	1991	1998	36	2001	2010
	Oxygen Demand, Chemical	143	1978	1990	127	1978	1990						
	pH	352	1978	2011	240	1978	1998	45	1991	1998	37	2001	2010
	Turbidity	273	1978	2011	186	1978	1998	45	1991	1998	36	2001	2010
Metals	Nickel	98	1991	2011	43	1991	1998	45	1991	1998	11	2001	2010
N/A	Fecal Coliform	258	1978	2011	172	1978	1998	43	1991	1998	36	2001	2010
	Suspended Solids, Total	268	1978	2011	173	1978	1998	45	1991	1998	36	2001	2010

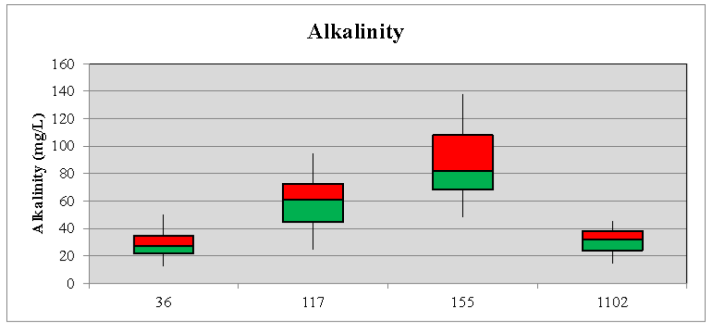


Figure A.1. Alkalinity boxplot

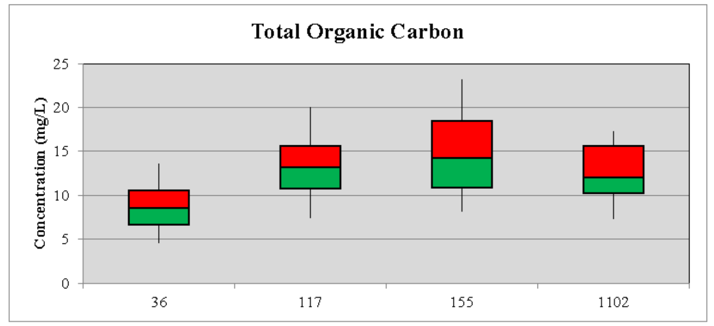


Figure A.2. Total Organic Carbon boxplot

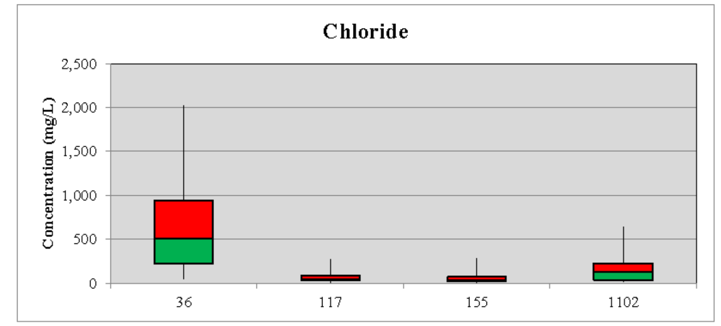


Figure A.3. Chloride boxplot

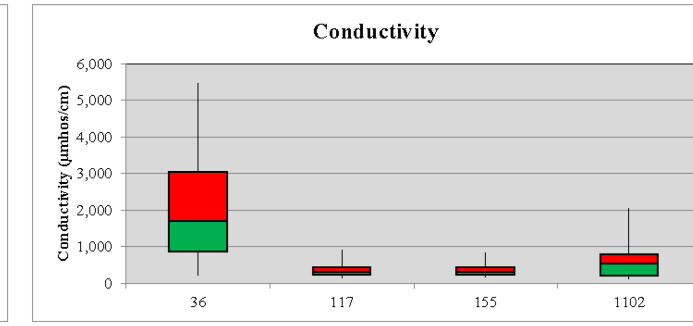


Figure A.4. Conductivity boxplot

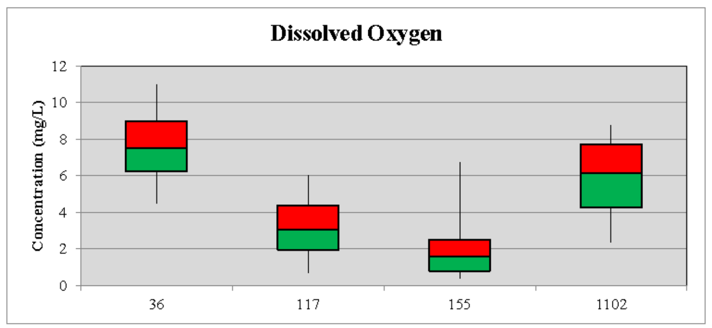


Figure A.5. Dissolved oxygen boxplot

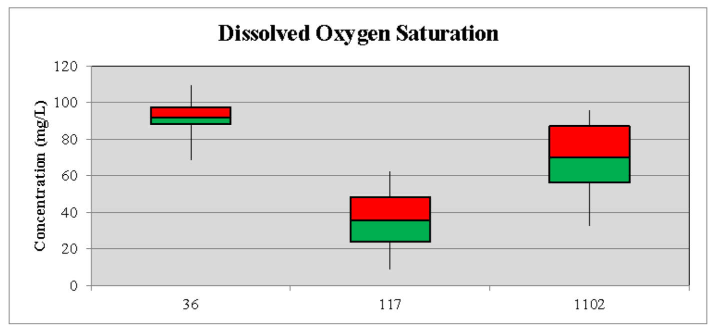


Figure A.6. Dissolved oxygen saturation boxplot

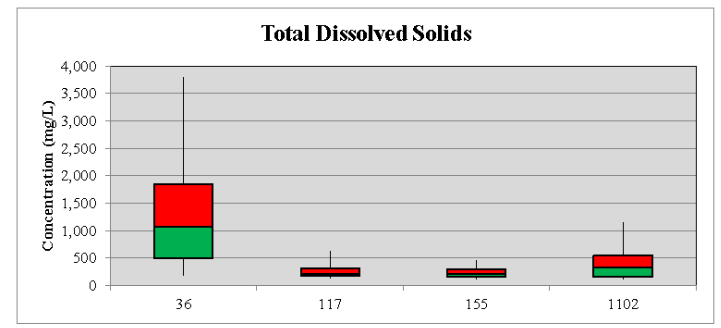


Figure A.7. Total dissolved solids boxplot

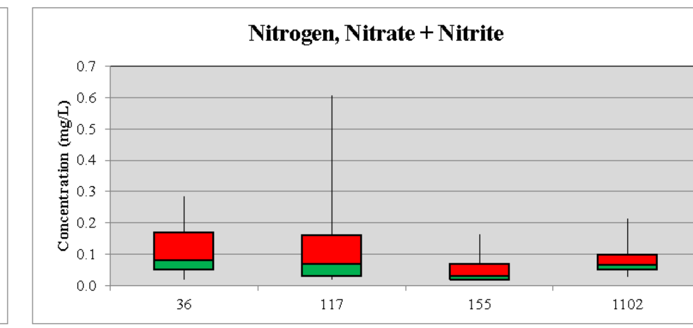


Figure A.8. Nitrate plus nitrite boxplot

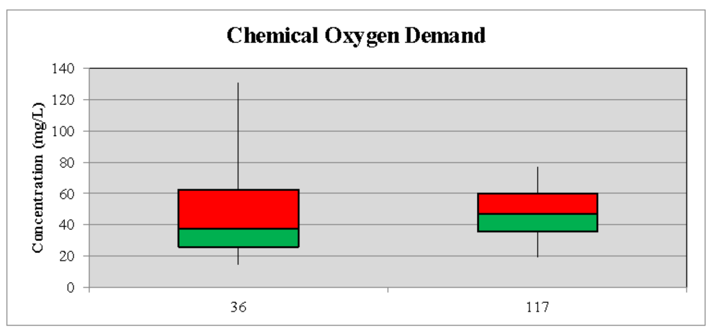


Figure A.9. Chemical oxygen demand boxplot

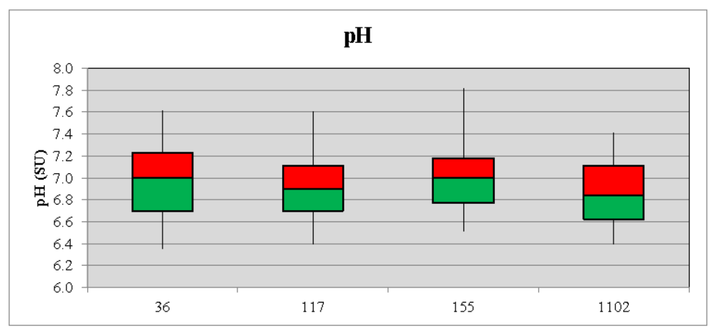


Figure A.10. pH boxplot

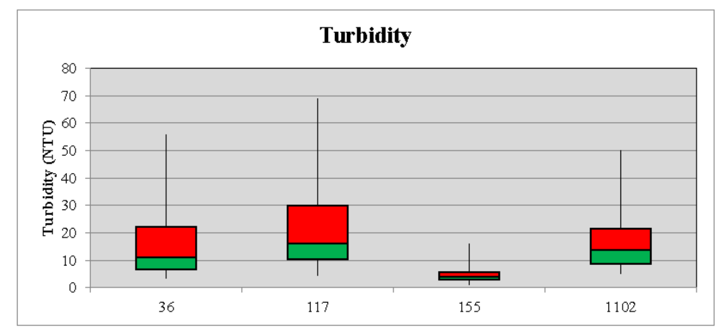


Figure A.11. Turbidity boxplot

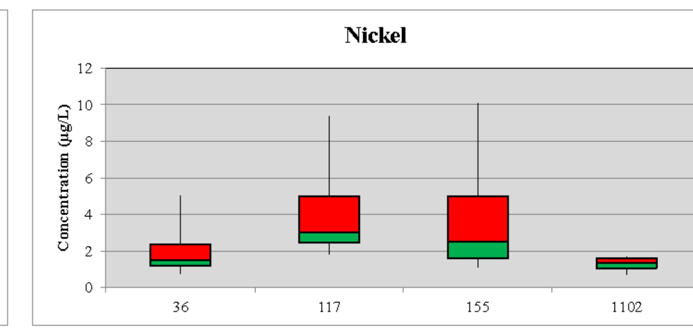


Figure A.12. Nickel boxplot

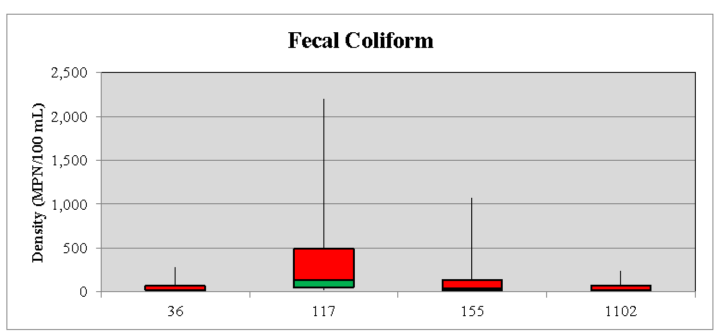


Figure A.13. Fecal Coliform boxplot

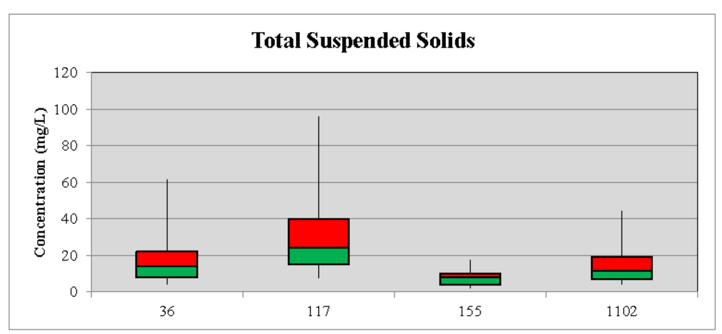


Figure A.14. Total suspended solids boxplot

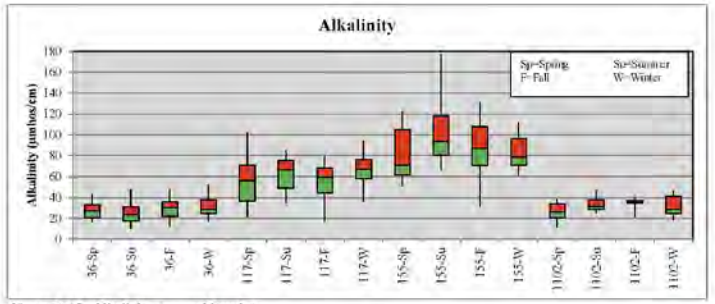


Figure A.15. Alkalinity seasonal boxplot

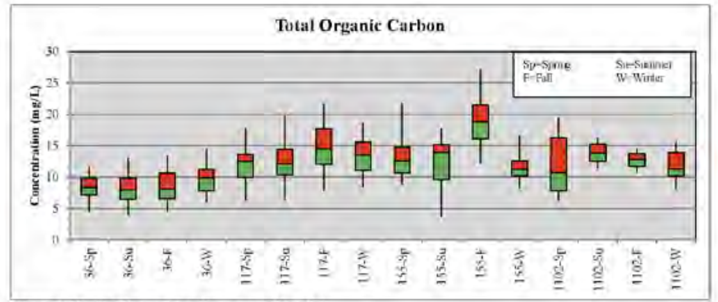


Figure A.16. Total organic carbon seasonal boxplot

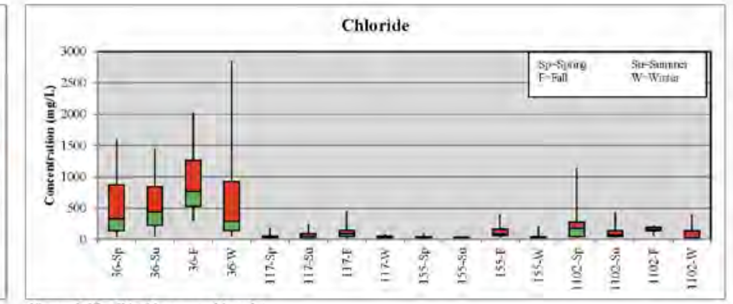


Figure A.17. Chloride seasonal boxplot

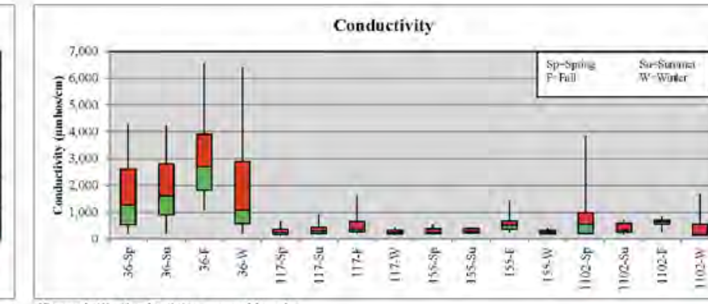


Figure A.18. Conductivity seasonal boxplot

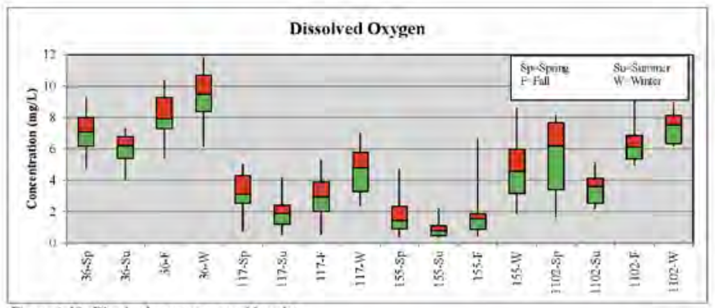


Figure A.19. Dissolved oxygen seasonal boxplot

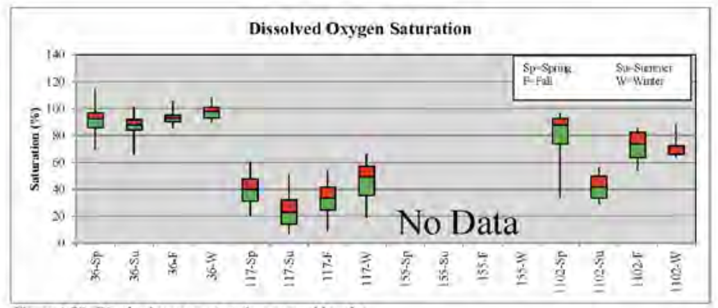


Figure A.20. Dissolved oxygen saturation seasonal boxplot

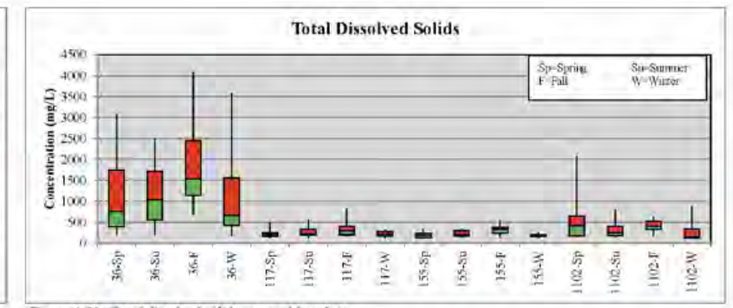


Figure A.21. Total dissolved solids seasonal boxplot

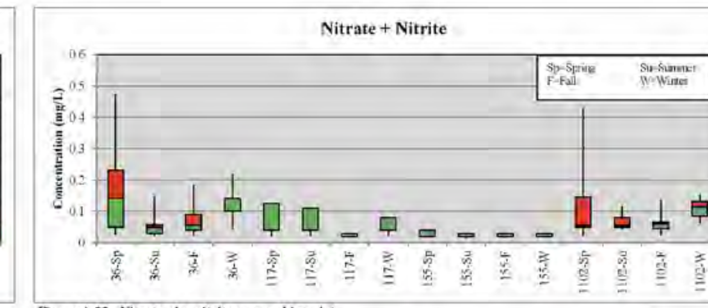


Figure A.22. Nitrate plus nitrite seasonal boxplot

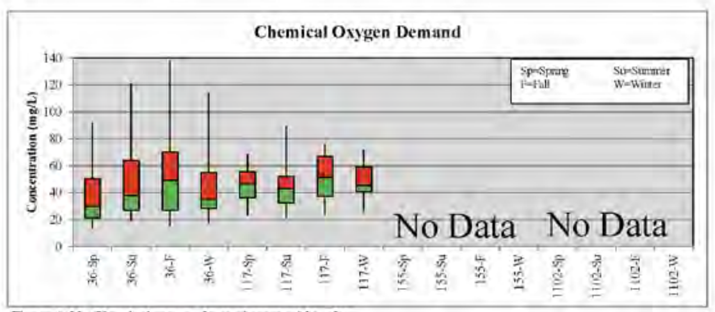


Figure A.23. Chemical oxygen demand seasonal boxplot

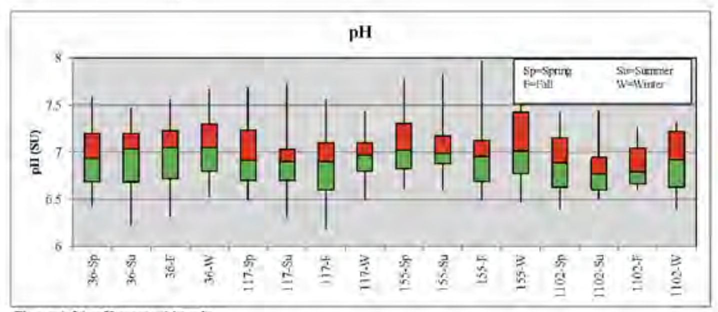


Figure A.24. pH seasonal boxplot

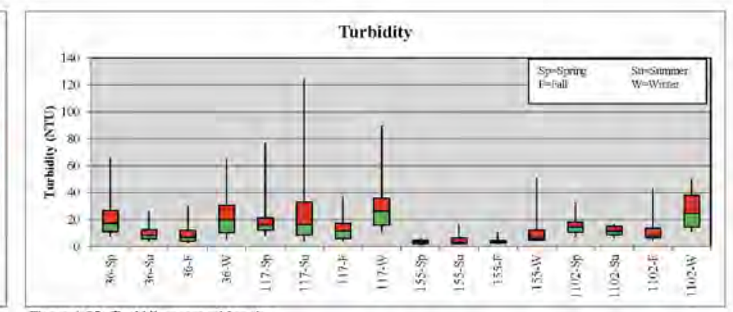


Figure A.25. Turbidity seasonal boxplot

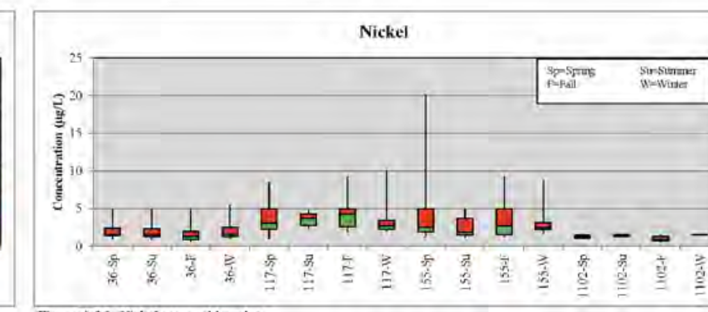


Figure A.26. Nickel seasonal boxplot

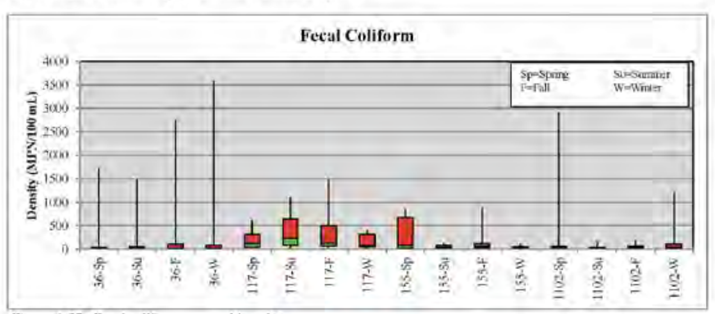


Figure A.27. Fecal coliform seasonal boxplot

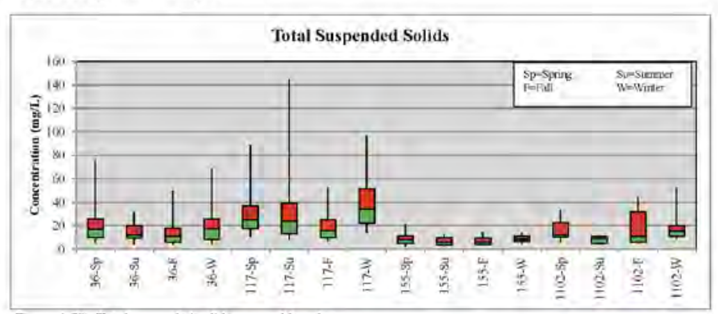


Figure A.28. Total suspended solids seasonal boxplot

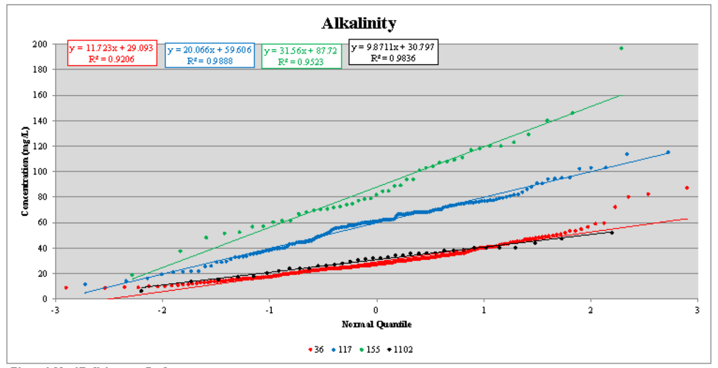


Figure A.29. Alkalinity quantile plot

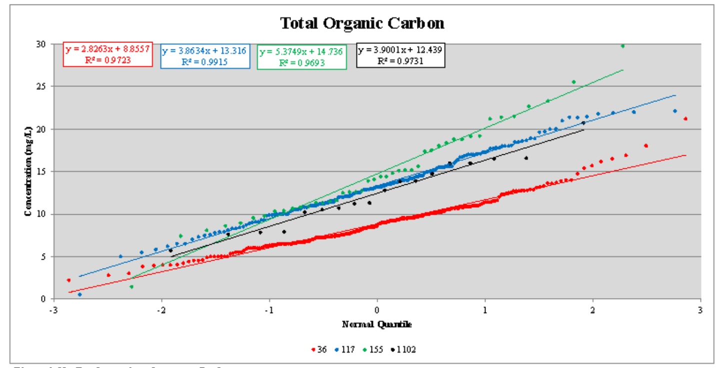


Figure A.30. Total organic carbon quantile plot

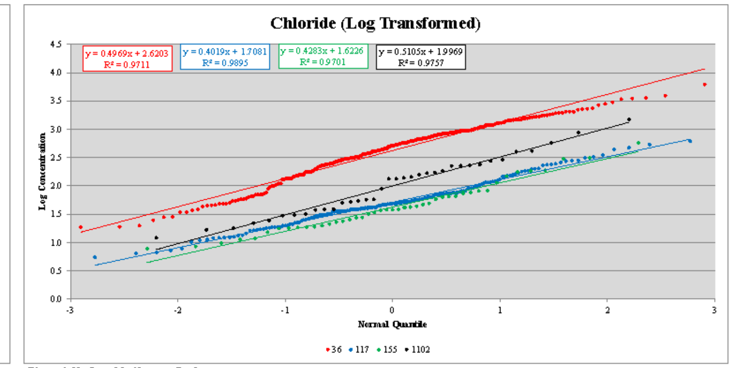


Figure A.31. Log chloride quantile plot

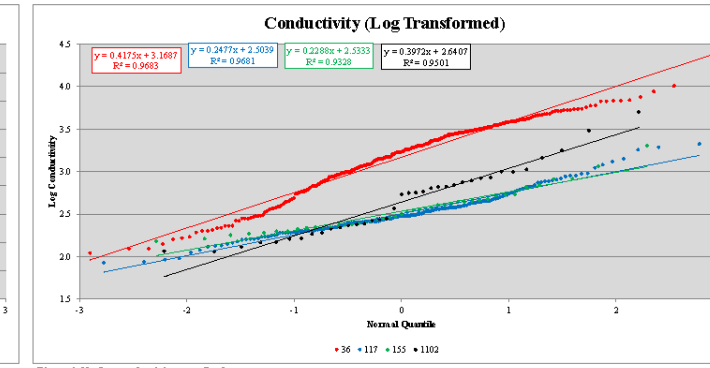


Figure A.32. Log conductivity quantile plot

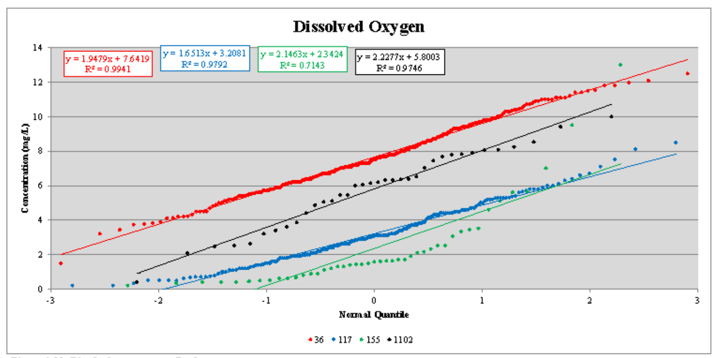


Figure A.33. Dissolved oxygen quantile plot

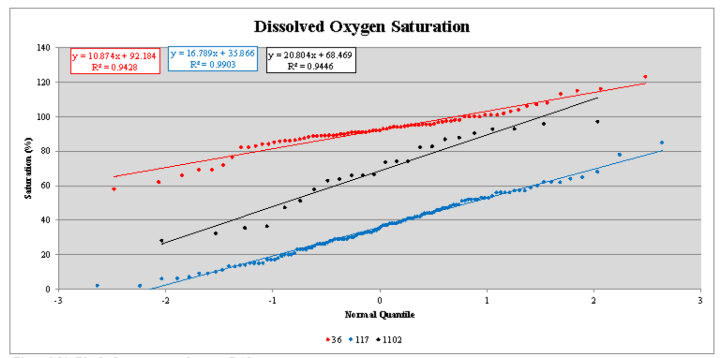


Figure A.34. Dissolved oxygen saturation quantile plot

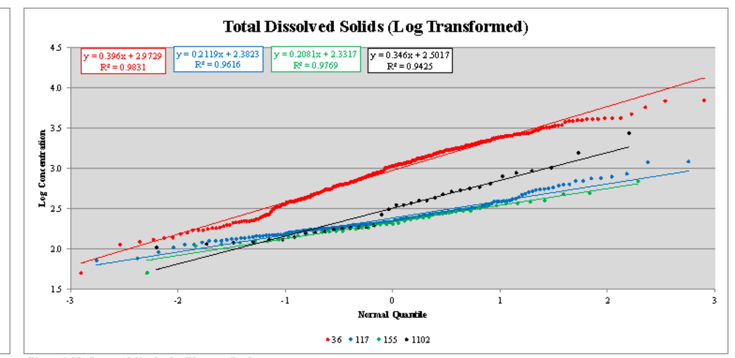


Figure A.35. Log total dissolved solids quantile plot

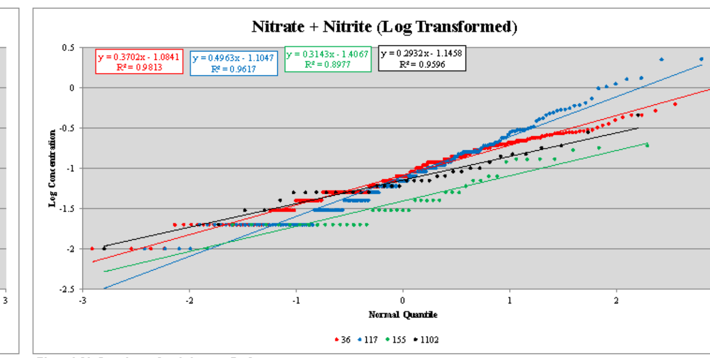


Figure A.36. Log nitrate plus nitrite quantile plot

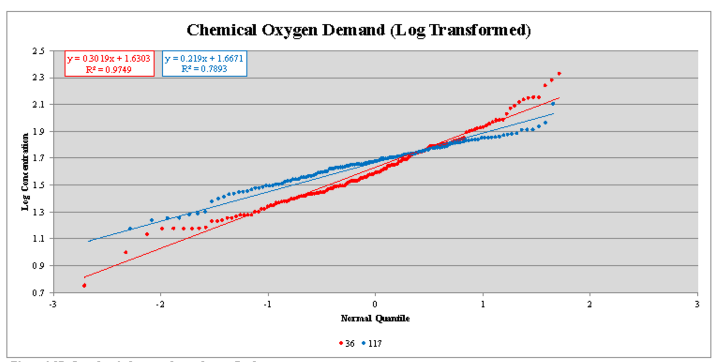


Figure A.37. Log chemical oxygen demand quantile plot

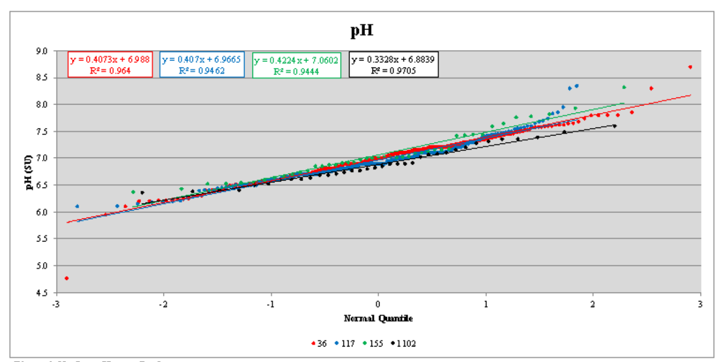


Figure A.38. Log pH quantile plot

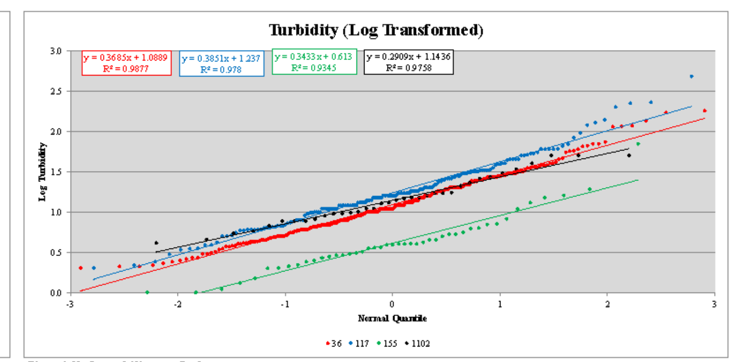


Figure A.39. Log turbidity quantile plot

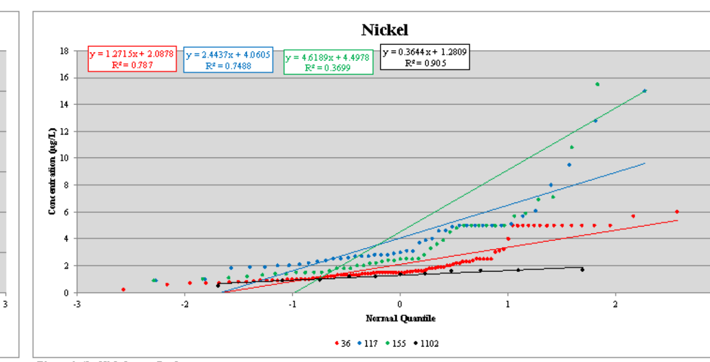


Figure A.40. Nickel quantile plot

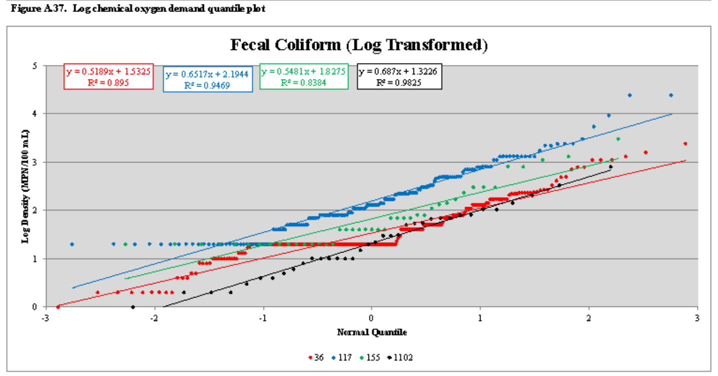


Figure A.41. Log Fecal Coliform quantile plot

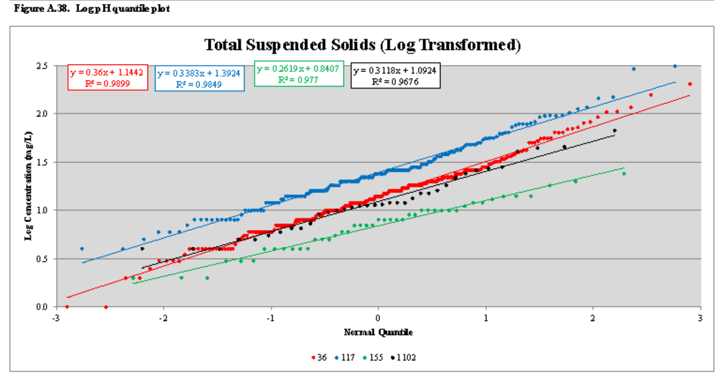


Figure A.42. Log total suspended solids quantile plot

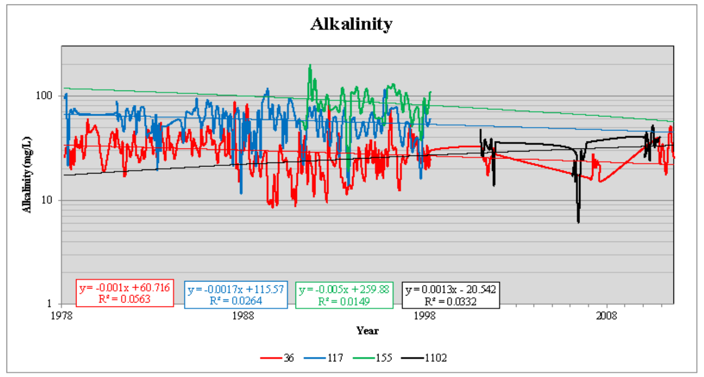


Figure A.43. Alkalinity trend

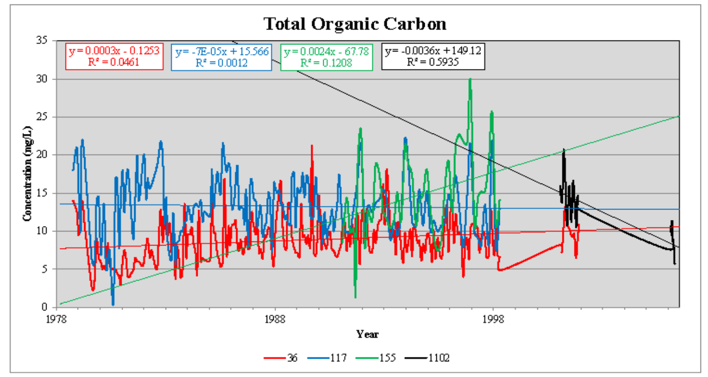


Figure A.44. Total organic carbon trend

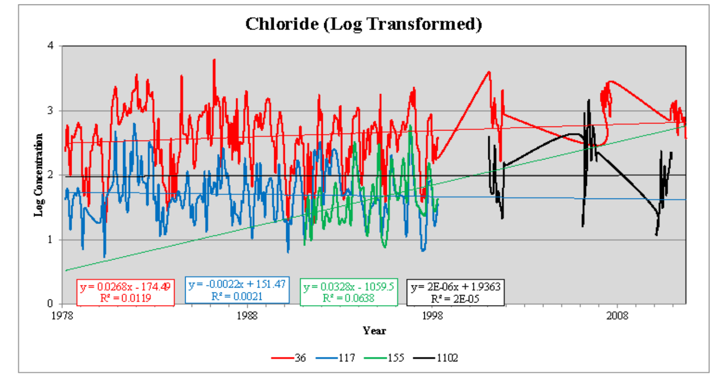


Figure A.45. Log chloride trend

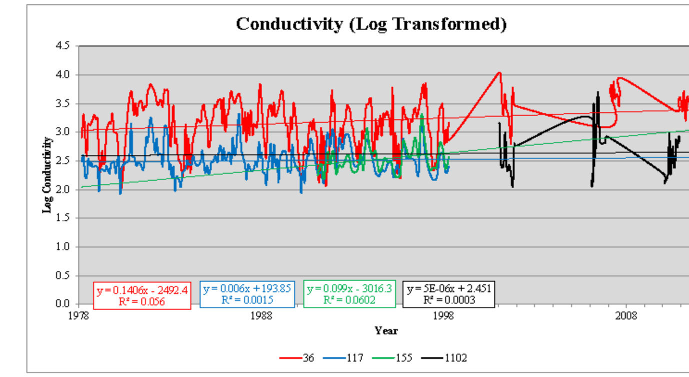


Figure A.46. Log conductivity trend

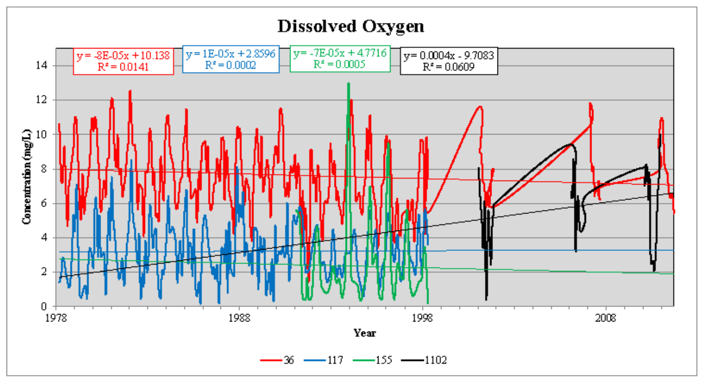


Figure A.47. Dissolved oxygen trend

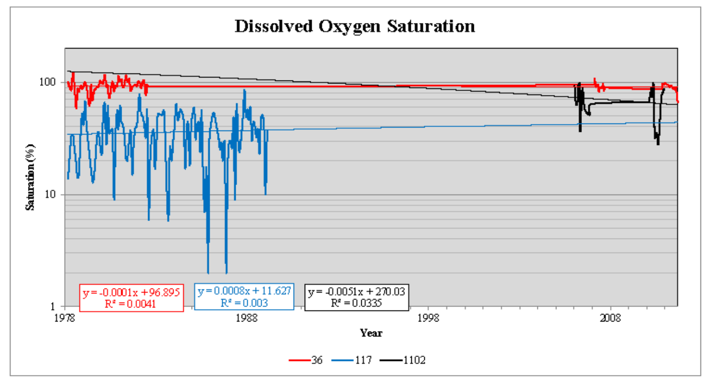


Figure A.48. Dissolved oxygen saturation trend

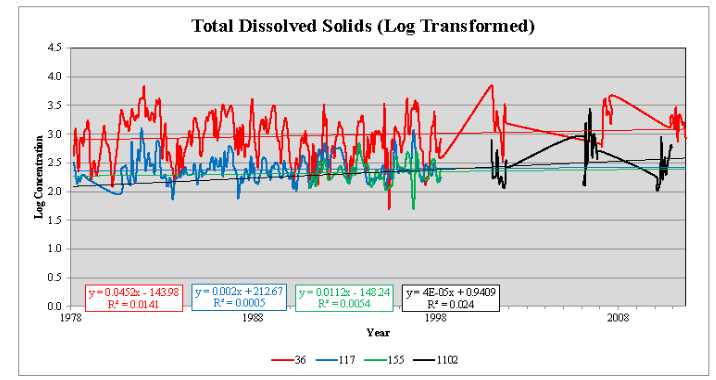


Figure A.49. Log total dissolved solids trend

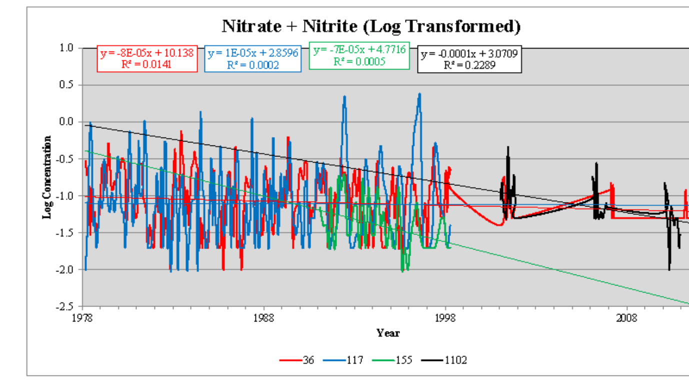


Figure A.50. Log nitrate plus nitrite trend

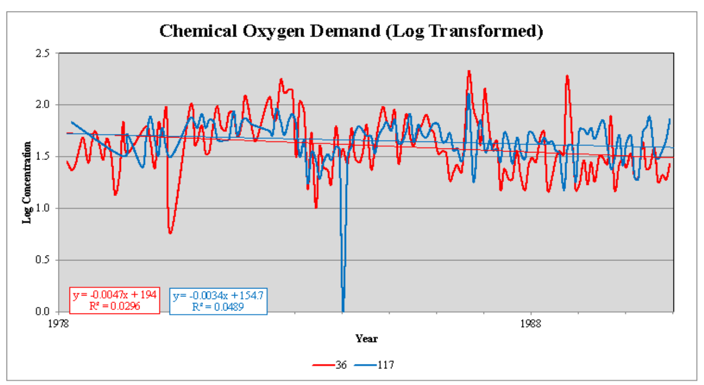


Figure A.51. Log chemical oxygen demand trend

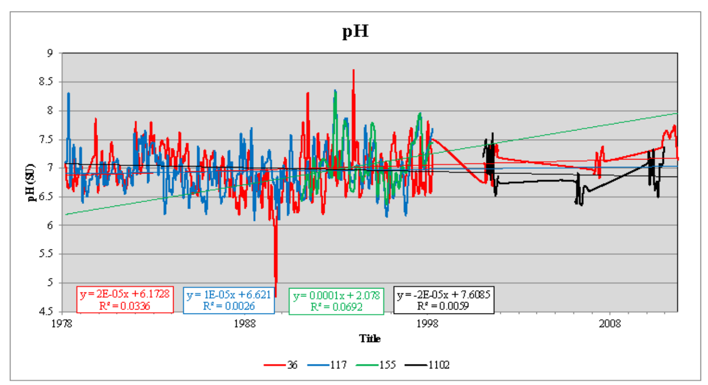


Figure A.52. pH trend

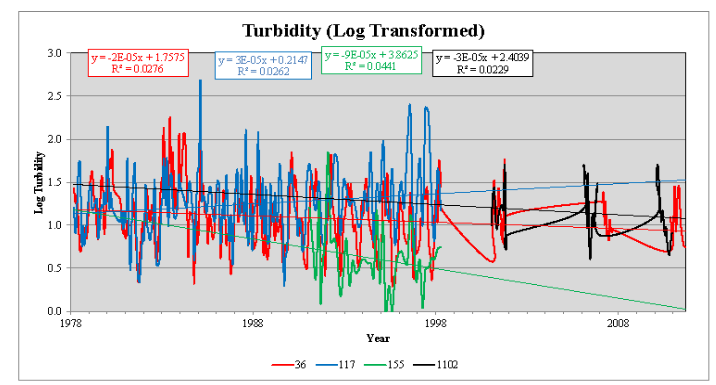


Figure A.53. Turbidity trend

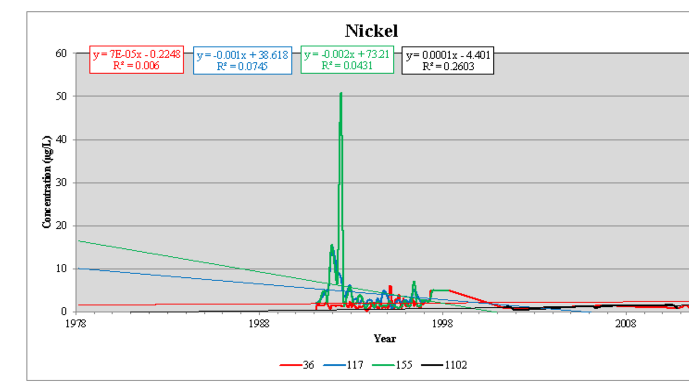


Figure A.54. Nickel trend

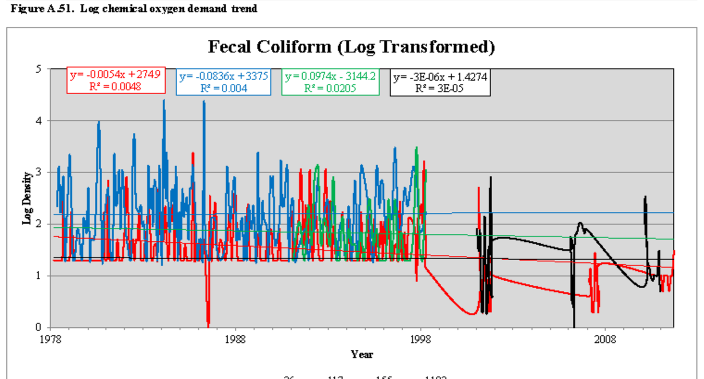


Figure A.55. Log fecal coliform trend

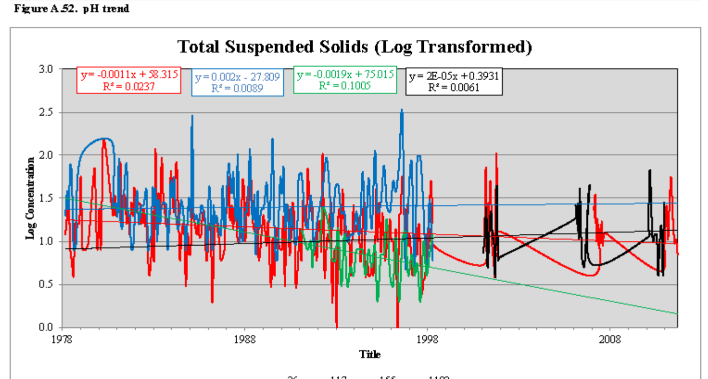


Figure A.56. Log total suspended solids trend

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

ENGINEERING
APPENDIX B

Contents

General

The Study area is located west of the Bonnet Carre Spillway between the Mississippi River and Lakes Pontchartrain and Maurepas in Southeast Louisiana. The project's purpose is to provide hurricane and storm damage risk reduction to developed areas of St. Charles, St. John the Baptist and St. James Parishes. Three alternatives (levee alignments) were evaluated (each with several features, including levees, floodwalls, floodgates and pumping stations) in order to select the best approach to reduce hurricane/tropical storm surge (hereafter "storm surge") in communities throughout the study area. Each alternative also evaluated environmental measures designed to protect and/or minimize the impacts to nearby wetlands and transportation evacuation routes (such as I-10 and U.S. 61) located in the study area. Figure 1 displays the 3 alternative alignments under consideration.

Information provided herein is based on modeling for a 100-year level of protection in the Baseline Year of 2020. This is also known as the base year and is part of a 50 year planning horizon that the Corps designs projects on. 2020 was decided as the base year for economic and hydraulic conditions since it is possible that the proposed levee could be designed and constructed by 2020 were funding and authority available to do so. All information is subject to change based on further evaluation conducted during feasibility level of design and analysis. A description of each alternative follows.

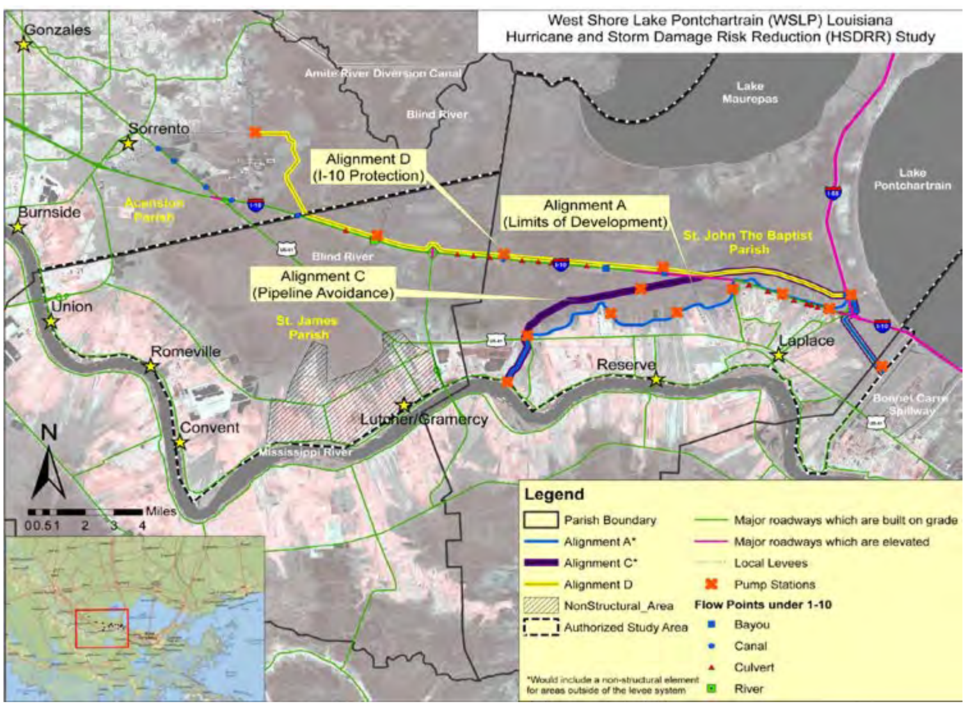


Figure 1: The Three Alternative Alignments

Alternative A

Alternative A starts at the Upper Guide Levee of the Bonnet Carre Spillway in St. Charles Parish, LA (north of the transmission and pipeline corridors), extends west around the I-10/I-55 interstate interchange and ends at the Mississippi River Levee just west of the Hope Canal in St. John the Baptist Parish, LA, a distance of 20.41 miles. The earthen levee generally follows the wet/dry interface. The following information is based on modeling for a 100-year level of protection in the Baseline Year of 2020 for a project life of 50 years and is subject to change based on further evaluation conducted during feasibility.

The top of levee elevation (net elevation) for this alignment ranges from El. 13.5 NAVD88 on the eastern reaches of the levee near the Bonnet Carre Spillway and gradually tapering to El. 7.0 NAVD88 as the levee moves west across the project .

Floodwalls

Ten Floodwalls (T-type walls), comprising a total of 4,774 linear feet, range from 10 ft. to 19 ft. in height; the top of wall design elevation is El. 17.0 NAVD88. The floodwalls, for the most part, are located where the alignment runs under I-10 and the I-10/I-55 interchange.

Floodgates

Nine Floodgates, comprising a total of 1,218 linear feet, range from 10 ft. to 19 ft. in height; the top of gate design elevation is El. 17.0 NAVD88. The floodgates, for the most part, are located along the alignment, usually where canals and roads are. Additionally, two 25-ft. wide railroad swing gates (each 11 ft. high) are included for those instances where the levee crosses the railroad.

Drainage Structures

Gravity Drainage Structures (with sluice gates), comprising a total of 240 linear feet, range from 20 ft. to 29 ft. in width. These are located near proposed pumping stations.

Pumping Stations

There are 8 pumping stations located along the alignment. The different sizes (which assumes there is no storage capacity available) are as follows:

2 at 240 cfs each

1 at 328 cfs

1 at 400 cfs

2 at 460 cfs each

1 at 656 cfs

1 at 787 cfs

Pumping stations are located at the various canals that cross the alignment, such as the Hope, Mississippi Bayou, Reserve Relief, Ridgefield, Vicknair and Montz Canals. It is generally expected that the gates would be closed, and the pumps would be operated during storm surge. Pumping would continue until the water level returns to existing natural water level conditions (currently estimated to be El. 2.0 NGVD), at which time the operation of the pumps would be discontinued and the gates would be opened.

Pipeline Relocations

There are numerous pipeline relocations involved in this alignment. The diameters of the various pipelines are as follows:

6 in. and less	18 pipelines
12 in. and less (but greater than 6 in.)	40 pipelines
24 in. and less (but greater than 18 in.)	11 pipelines
Greater than 24 in.	1 pipeline

<u>Alternative C (TSP)</u>

Alternative C starts at the Upper Guide Levee of the Bonnet Carre Spillway in St. Charles Parish, LA (north of the transmission and pipeline corridors), extends west around the I-10/I-55 interstate interchange and ends at the Mississippi River Levee just west of the Hope Canal in St. John the Baptist Parish, LA, a distance of 18.27 miles. The following information is based on modeling for a 100-year level of protection in the Baseline Year of 2020 for a project life of 50 years and is subject to change based on further evaluation conducted during feasibility.

The top of levee elevation (net elevation) for this alignment ranges from El. 13.5 NAVD88 on the eastern reaches of the levee near the Bonnet Carre Spillway and gradually tapering to El. 7.0 NAVD88 as the levee moves west across the project area.

Floodwalls

Nine Floodwalls (T-type walls), comprising a total of 5,304 linear feet, range from 10 ft. to 19 ft. in height; the top of wall design elevation is El. 17.0 NAVD88. The floodwalls, for the most part, are located where the alignment runs under I-10 and the I-10/I-55 interchange.

Floodgates

Five Floodgates, comprising a total of 288 linear feet, range from 15 ft. to 19 ft. in height; the top of gate design elevation is El. 17.0 NAVD88 The floodgates, for the most part, are located along the alignment, usually where canals and roads are. Additionally, two 25-ft. wide railroad swing gates (each 11 ft. high) are included for those instances where the levee crosses the railroad.

Drainage Structures

Gravity Drainage Structures (with sluice gates), comprising a total of 208 linear feet, range from 25 ft. to 29 ft. in width. These are located near proposed pumping stations.

Pumping Stations

There are 4 pumping stations located along the alignment. The different sizes (which assumes there is no storage capacity available) are as follows:

1 at 200 cfs

1 at 400 cfs

1 at 450 cfs

1 at 1,100 cfs

Pumping stations are located at the various canals that cross the alignment, such as the Montz, Reserve Relief and Ridgefield Canals, as well as a local canal near Baseline Station 933+00. It is generally expected that the gates would be closed, and the pumps would be operated during storm surge. Pumping would continue until the water level returns to existing natural water level conditions (currently estimated to be El. 2.0), at which time the operation of the pumps would be discontinued and the gates would be opened.

Pipeline Relocations

There are numerous pipeline relocations involved in this alignment. The diameters of the various pipelines are as follows:

6 in. and less	14 pipelines
12 in. and less (but greater than 6 in.)	16 pipelines
24 in. and less (but greater than 18 in.)	5 pipelines
Greater than 24 in.	1 pipeline

Access Routes and Staging Areas

Access routes and staging areas have not been determined at this time, but potential access routes and staging areas will be identified during the feasibility-level design of the tentatively selected plan (TSP) alignment. During the P.E.D. phase of the project, these routes and staging areas will be finalized.

Borrow Sources

Borrow material for this project would come from the Bonnet Carré Spillway or alternative borrow sources not yet identified. Potential borrow pits will be identified during the feasibility-level design of the TSP alignment. During the P.E.D. phase of the project, , identification and environmental clearance of these pits will be finalized and right of way drawings will be prepared in anticipation of submitting a request to the NFS to obtain the necessary real estate rights and interests.

Alternative D

Alternative D starts at the Upper Guide Levee of the Bonnet Carre Spillway in St. Charles Parish, LA (north of the transmission and pipeline corridors), extends west around the I-10/I-55 interstate interchange, continues west along I-10 and ends at the Marvin Braud Pumping Station, in the vicinity of Sorrento (within the McElroy Swamp) in Ascension Parish, LA, a distance of 28.28 miles. The following information is based on modeling for a 100-year level of protection in the Baseline Year of 2020 for a project life of 50 years and is subject to change based on further evaluation conducted during feasibility.

The top of levee elevation (net elevation) for this alignment ranges from El. 13.5 NAVD88 on the eastern reaches of the levee near the Bonnet Carre Spillway and gradually tapering to El. 8.0 NAVD88 as the levee moves west across the project area.

Floodwalls

Six Floodwalls (T-type walls), comprising a total of 4,011 linear feet, range from 15 ft. to 19 ft. in height; the top of wall design elevation is El. 17.0 NAVD88. The floodwalls, for the most part, are located where the alignment runs under I-10 and the I-10/I-55 interchange.

Floodgates

Three Floodgates, comprising a total of 306 linear feet, range from 15 ft. to 19 ft. in height; the top of gate design elevation is El. 17.0 NAVD88. The floodgates, for the most part, are located along the alignment, usually where canals and roads are.

Drainage Structures

Gravity Drainage Structures (with sluice gates), comprising a total of 396 linear feet, range from 20 ft. to 29 ft. in width. These are located near proposed pumping stations. For the Bayou Conway area, the required channel size is 24 ft. wide x 12 ft. deep (to convey 1,100 cfs of flow). For the Blind River area, the required channel size is 40 ft. wide x 20 ft. deep (to convey 4,500 cfs of flow).

Pumping Stations

There are 6 pumping stations located along the alignment. The different sizes (which assume there is no storage capacity available) are as follows:

1 at 200 cfs

1 at 400 cfs

1 at 450 cfs

2 at 1,100 cfs each (this includes the Bayou Conway area)

1 at 4,500 cfs (this is for the Blind River area)

Pumping stations are located at the various canals that cross the alignment, such as the Montz, Reserve Relief and Ridgefield Canals, as well as a local canal near approx. Baseline Station 951+00 and the Bayou Conway and Blind River areas. It is generally expected that the gates would be closed, and the pumps would be operated during storm surge. Pumping would continue until the water level returns to existing natural water level conditions (currently estimated to be El. 2.0), at which time the operation of the pumps would be discontinued and the gates would be opened.

Pipeline Relocations

There are numerous pipeline relocations involved in this alignment. The diameters of the various pipelines are as follows:

6 in. and less	7 pipelines
12 in. and less (but greater than 6 in.)	6 pipelines
24 in. and less (but greater than 18 in.)	1 pipeline

There are at least two instances where the pipeline would cross through the floodwall (at approx. Baseline Station 1382+00 and at approx. Baseline Station 1404+00).

Culverts

There are 6 culverts (in addition to the culverts that exist under I-10) that facilitate tidal exchange of water with the wetlands.

Hydraulics and Hydrology

Interior Drainage

The interior drainage analysis for the feasibility study was broken down into two stages:

1) Determine the rough-order-of-magnitude (ROM) capacities of gravity drainage structures and pumps recommended to prevent project induced flooding for each of the proposed alignments (A, C, and D).

2) For the tentatively selected plan (TSP), determine the capacities of gravity drainage structures and pumps using a detailed rainfall-runoff analysis.

For the ROM phase of the analysis, pump and gravity drainage recommendations were determined using an XP-SWMM model completed during the reconnaissance phase of the study for Alignments A and C. Figure 2 depicts the storage basin layout for used in the model. These basins correspond to the sizes and capacities listed in Table 1. Alignment D covers the area of Alignment C in addition to the drainage basins of the Blind River and Bayou Conway. Structures and pumps were sized for Blind and Conway using the HEC-HMS and HEC-RAS modeling suite. The recommendations are also listed in Table 1. All design values are based on a 10-yr, 24-hr rainfall.

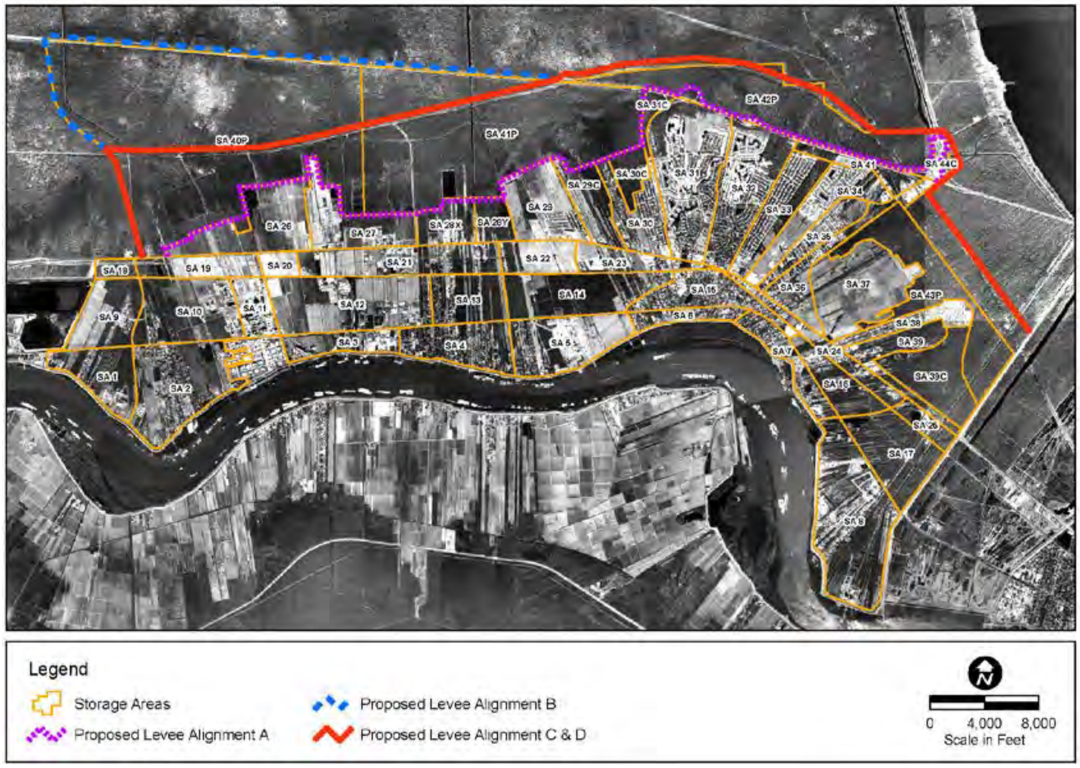


Figure 2: Storage Basin Layout

Table 1: ROM Determinations

Item / Location:	Alignment A	Alignment C and D	Blind River and Bayou Conway (Alignment D only)
Gravity Drain, SA-40P	1 RCBC*, 6' High by 20' Wide	1 RCBC, 6' High by 20' Wide	
Gravity Drain, SA-41P	2 RCBC's, 6' High by 20' Wide	2 RCBC's, 6' High by 20' Wide	
Gravity Drain, SA-42P	2 RCBC's, 6' High by 18' Wide	2 RCBC's, 6' High by 18' Wide	
Gravity Drain, SA-43P	2 RCBC's, 6' High by 18' Wide	2 RCBC's, 6' High by 18' Wide	
Pump Station, SA-40P	480 cfs	450 cfs	
Pump Station, SA-41P	1180 cfs	400 cfs	
Pump Station, SA-42P	920 cfs	200 cfs	
Pump Station, SA-43P	985 cfs	1100 cfs	
Gravity Drain, Blind River			40ft. wide, 20ft. deep rectangular cross section

Gravity Drain, Bayou Conway			24ft. wide, 12 ft. deep rectangular cross section is required
Pump Station, Blind River			1100 cfs
Pump Station, Bayou Conway			4500 cfs

*RCBC - Reinforced Concrete Box Culvert

Detailed interior drainage modeling is being performed on Alignment C as the Tentatively Selected Plan (TSP).

Storm Surge Modeling

State-of-the-Art coastal ocean hydrodynamic analysis methods were used to determine the storm surge and wave results. The modeling system for this study was established by fine-tuning existing models used previously for the Joint Storm Surge (JSS) Analysis in Southern Louisiana for the Louisiana Coastal Protection and Restoration (LACPR) project, as well as the recent flood insurance rate map modernization study conducted by the Federal Emergency Management Agency (FEMA) (USACE 2008a; USACE 2007).

The data gathered from Advanced Circulation (ADCIRC) and the Steady State Spectral Wave (STWAVE) modeling were used to generate surge and wave return values ranging from the 50 year return to the 2000 year return in 50 year increments. A set of 152 hurricane condition storm events were used to develop an existing (2011) condition and future conditions for a 2020 intermediate relative sea level rise (RSLR) and 2070 low, intermediate, and high RSLR as well as alternative alignments intermediate RSLR. The Joint Probability Method, with Optimum Sampling (JPM-OS) was applied for each data set to develop stage frequencies. The resulting levee design heights for the screening level effort for each alignment and for each condition (2011, 2020 and 2070) are shown on the following maps (Figures 3 through11). It should be noted that, for Figures 6 through 11, the notation of "Considering Intermediate Sea Level Rise" on each of these maps refers to Intermediate Relative Sea Level Rise.

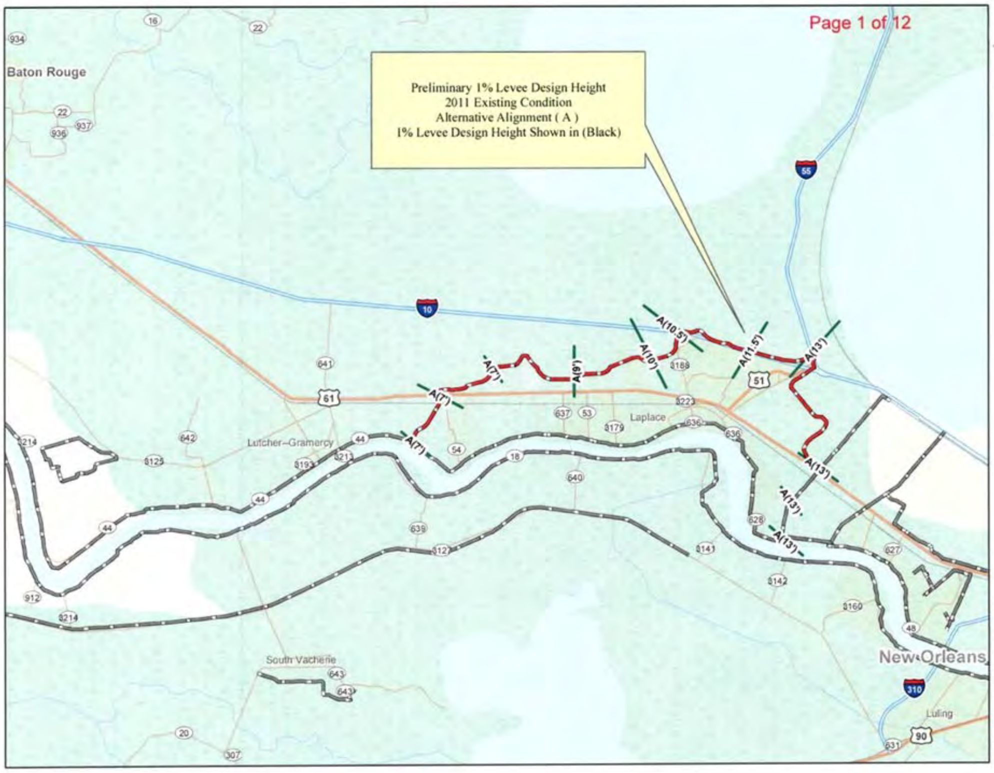


Figure 3: Levee Design Height Existing Conditions Alignment A

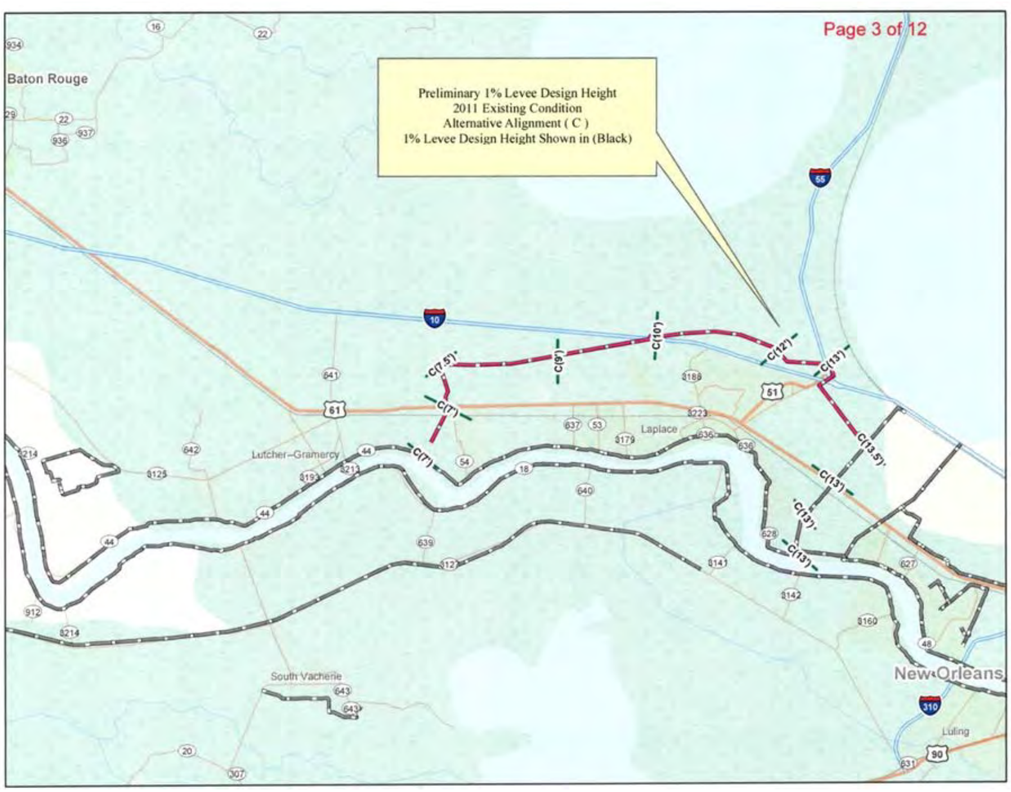


Figure 4: Levee Design Height Existing Conditions Alignment C (TSP)

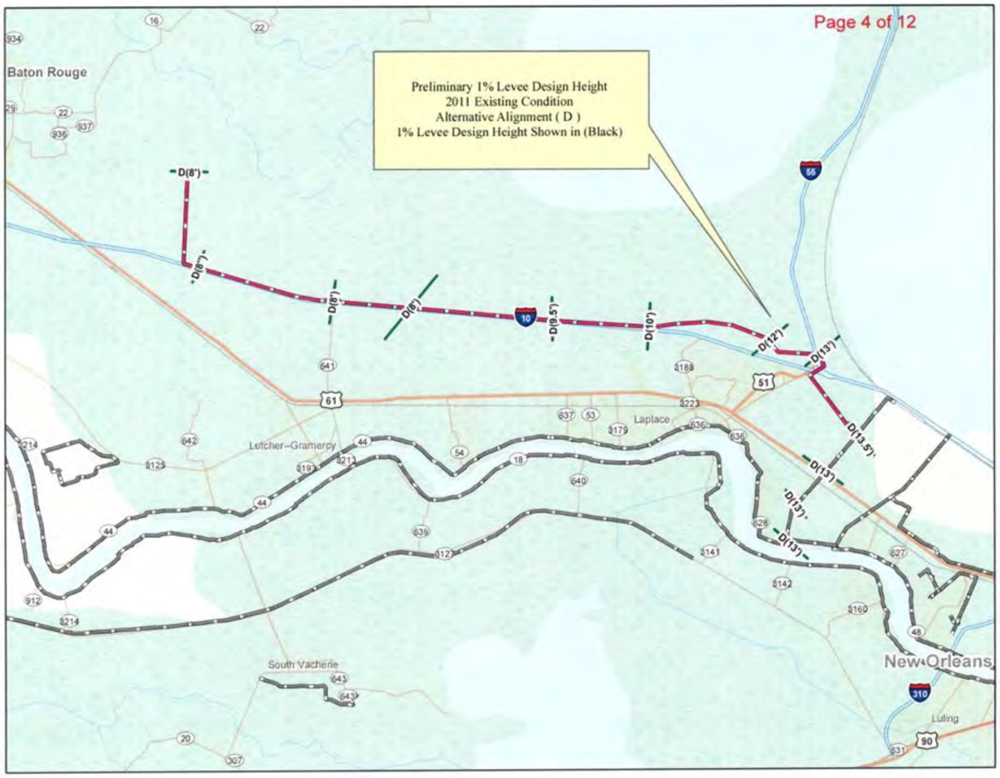


Figure 5: Levee Design Height Existing Conditions Alignment D

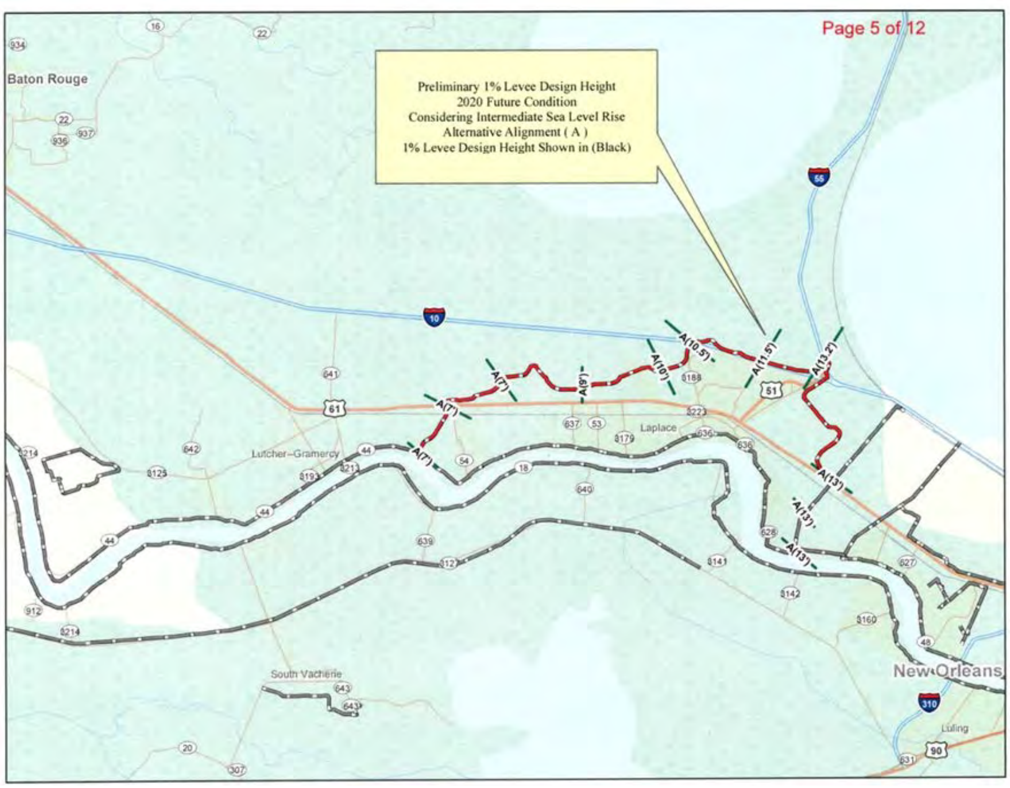


Figure 6: Levee Design Height 2020 Future Condition Alignment A

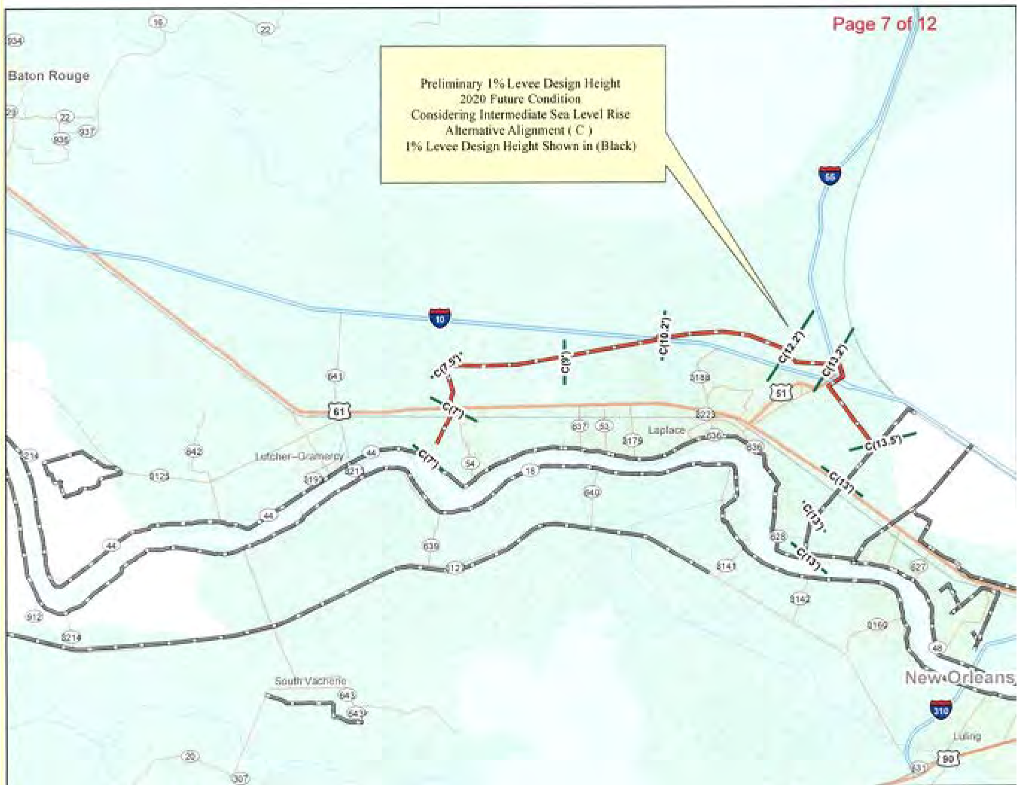


Figure 7: Levee Design Height 2020 Future Condition Alignment C (TSP)

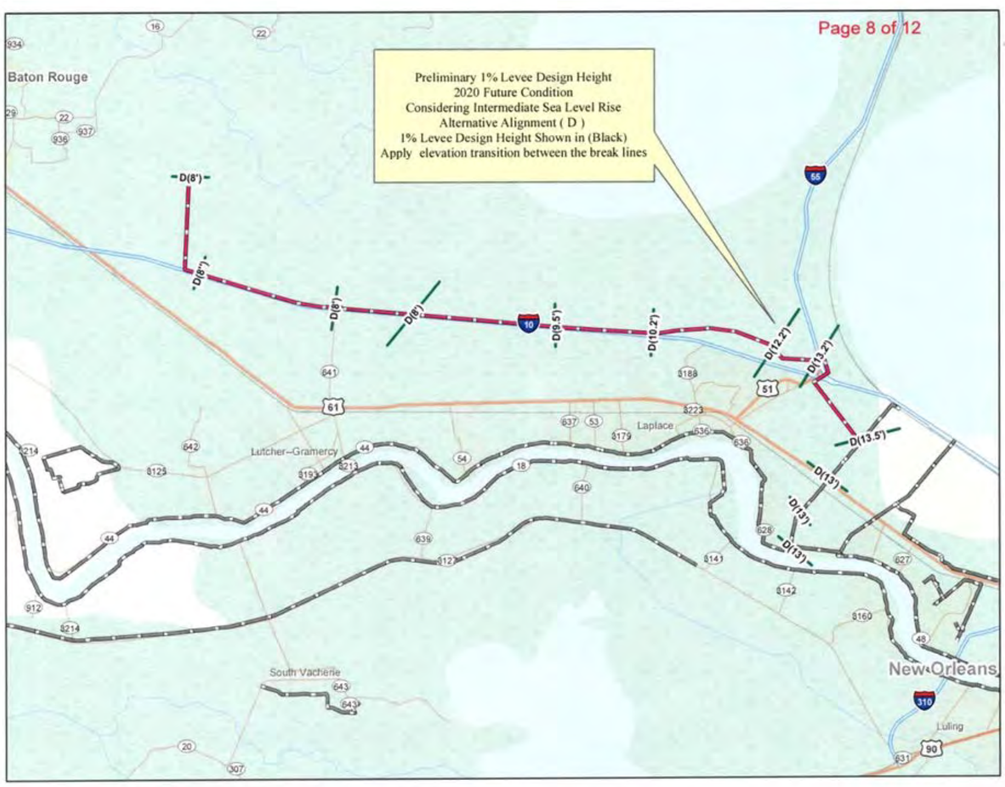


Figure 8: Levee Design Height 2020 Future Condition Alignment D

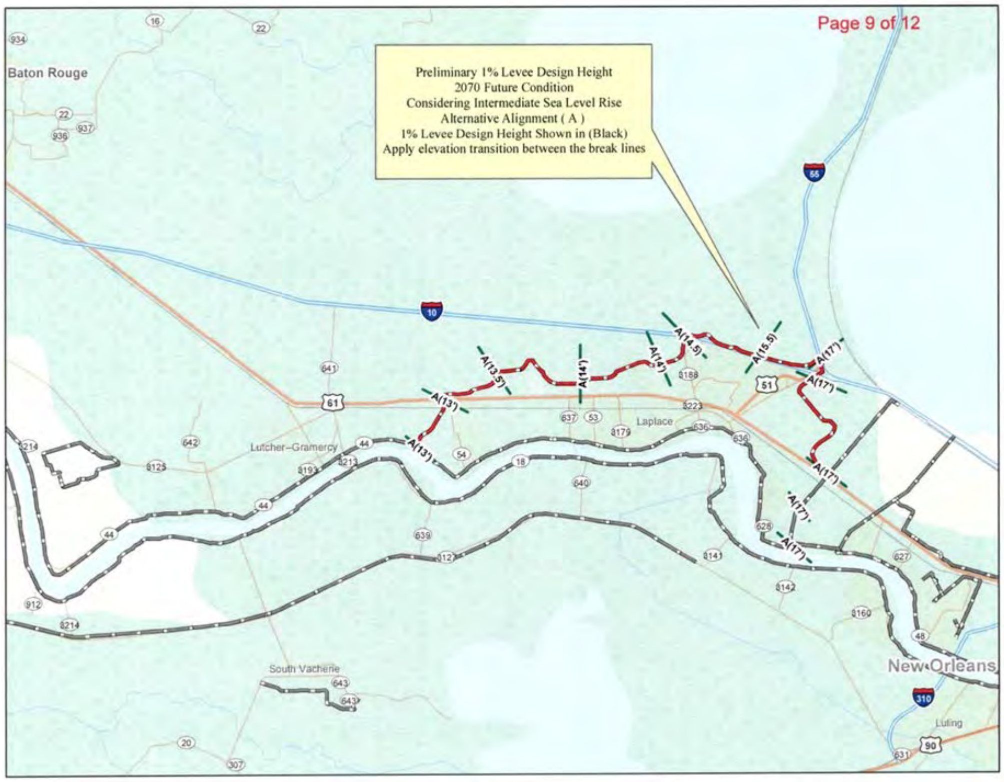


Figure 9: Levee Design Height 2070 Future Condition Alignment A

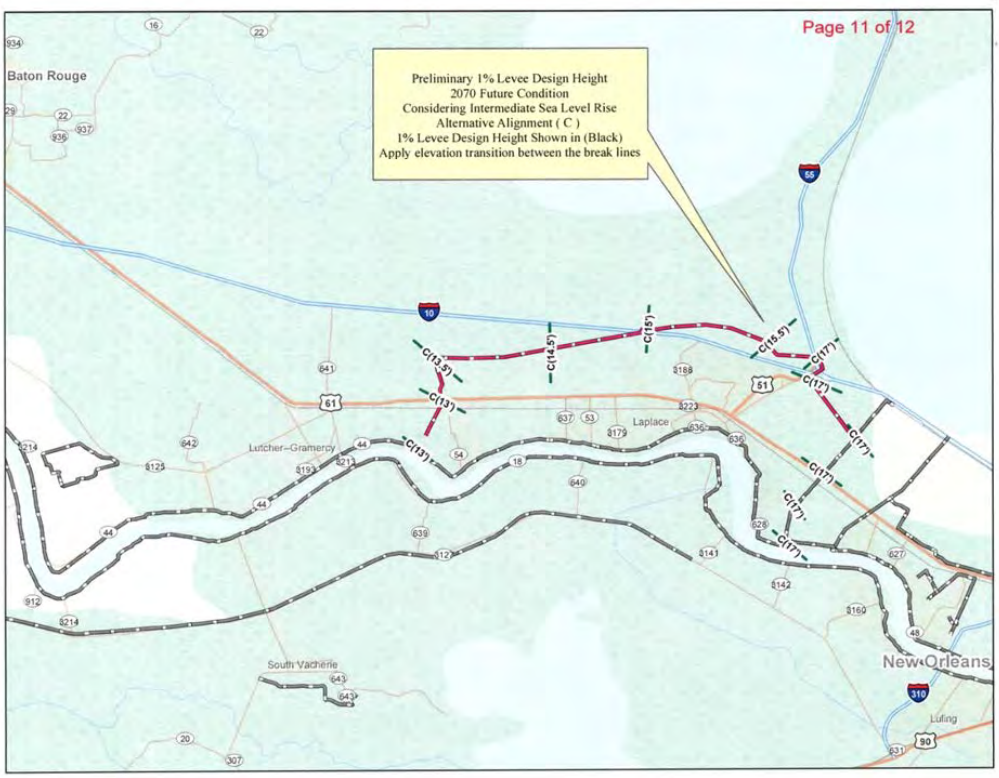


Figure 10: Levee Design Height 2070 Future Condition Alignment C (TSP)

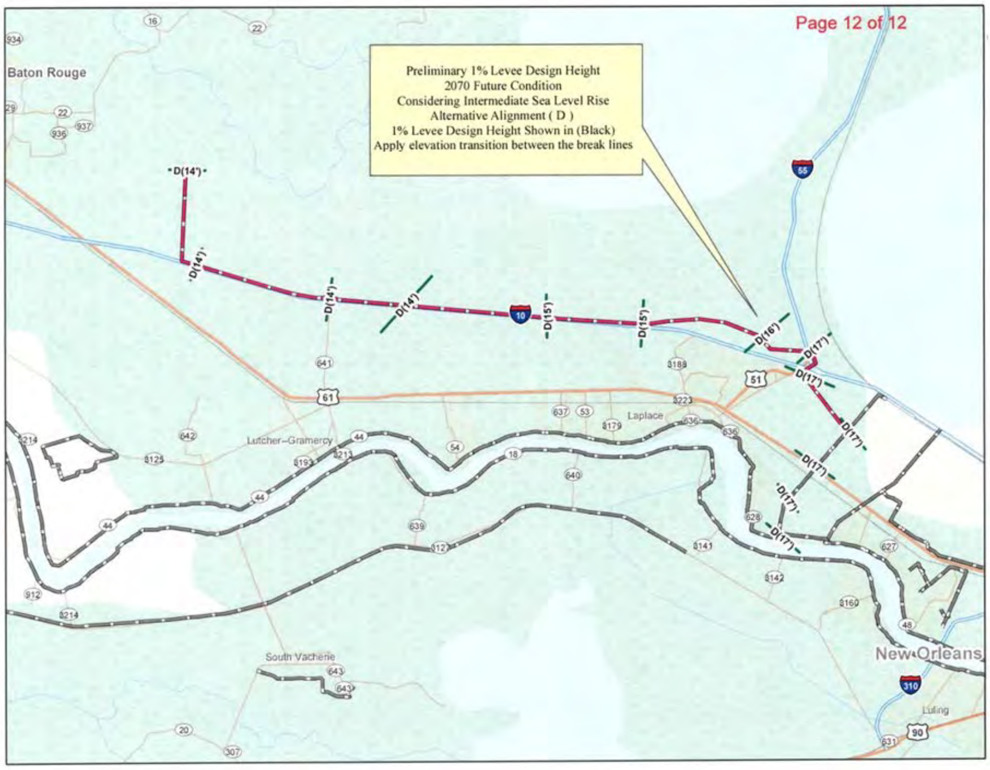


Figure 11: Levee Design Height 2070 Future Condition Alignment D

Additional storm surge modeling (including wave run-up and overtopping) will be performed on Alignment C as the Tentatively Selected Plan (TSP).

Potential Sea Level conditions are represented in the modeling system by application of a relative Sea Level Rise (RSLR) that is consistent with USACE EC 1165-2-211 (2009). Subsidence levels predicted in the study area were incorporated in the ADCIRC initial water level parameter to capture the combined effects of subsidence and local SLR into a single RSLR value. For the 2020 and 2070 simulations, unique RSLR values were added to the 2011 initial water surface elevations (WSE) to determine the initial WSE appropriate for each year and SLR rate. In addition to accounting for RSLR of future conditions, the 2070 scenarios accounted for potential degradation of vegetation in landscapes. SLR changes (as well as salinity intrusion) can cause an associated vegetation degradation and / or loss (this was considered in the ADCIRC modeling). Since these are slow-moving processes, forecasts of 50 years in the future were used, with intermediate RSLR conditions. See Figure 12 for SLR estimates for Years 2011 through 2080.

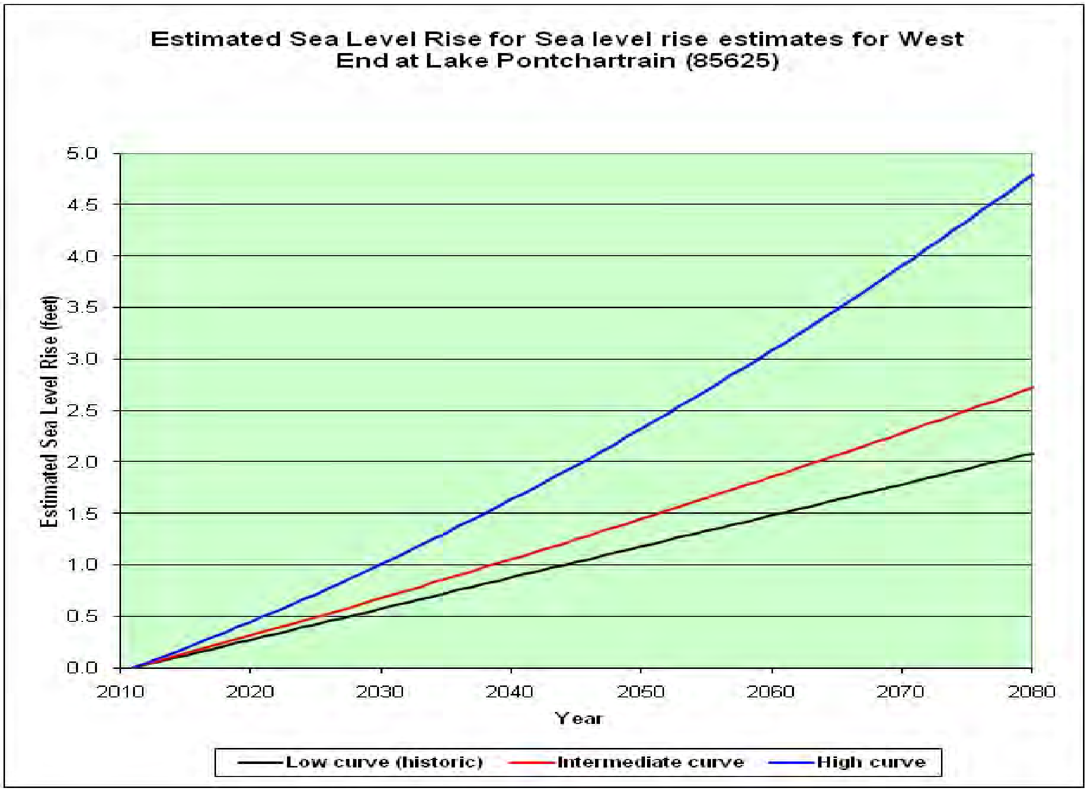


Figure 12: Estimated Sea Level Rise (SLR) for Years 2011 through 2070

Detailed Storm Surge and Wave Analysis (ADCIRC modeling), including SLR assumptions, for the screening level effort (April 2011) is available upon request.

Water Quality

This water resource is significant because of the Clean Water Act, as amended, the Pollution Prevention Act, the Safe Drinking Water Act, and the Water Resources Planning Act, regulations which provide for the protection of U.S. waters for the purposes of drinking, recreation, and wildlife. It also provides for the purposes of restoring and maintaining the chemical, physical, and biological integrity of the Nation's waters. Study area water quality is influenced by basin elevations, surface water budget, land cover and use, coastal and geological processes, and regional weather. The study area is in the southwestern portion of a basin consisting of uplands to the north and estuary to the south, with increasing estuary salinity eastward. The estuary has experienced hydromodification via the construction of canals and embankments. Historical study area water quality is depicted in several references which include the review of data from basin tributaries and estuary lakes and passes. Garrison (1999) provides a statistical summary of general parameters, major ions, nutrients, trace metals, and organic compounds for water quality data collected in Lake Maurepas between 1943 and 1995. Overall, the summary suggests the lake is freshwater, oligotrophic, and does not contain elevated contaminant levels. To determine the most prevalent water quality issues present in the study area, historical Section 305(b) lists were reviewed to determine the most significant causes and sources of subsegment impairment. The most current (2012) 303(d) list for the study area is depicted in Table 2. Ordered by decreasing frequency cited, suspected causes of impairment include non-native aquatic plants, low dissolved oxygen, mercury, elevated turbidity, and fecal coliform, while suspected sources of impairment include wetland habitat modification, introduction of non-native organisms, atmospheric deposition, unknown sources, on-site treatment systems, natural sources, and agriculture.

Table 2: Study Area 2013 303(d) List

Subsegment	Impaired Use for Suspected Cause	Suspected Cause of Impairment	Suspected Source of Impairment	IR Category	TMDL Priority
040401	FWP	Dissolved Oxygen	Wetland Habitat Modification	IRC 5	L
		Mercury	Atmospheric Deposition	IRC 4a	
			Source Unknown	IRC 4a	
		Non-Native Aquatic Plants	Introduction of Non-native Organisms	IRC 4b	
		Turbidity	Wetland Habitat Modification	IRC 4a	
	ONR	Turbidity	Wetland Habitat Modification	IRC 4a	
	PCR	Water Temperature	Natural Sources	IRC 5	L
			Wetland Habitat Modification	IRC 5	L
040403	FWP	Dissolved Oxygen	Agriculture	IRC 5	L
			Wetland Habitat Modification	IRC 5	L
		Mercury	Atmospheric Deposition	IRC 4a	
				IRC 5	L
			Source Unknown	IRC 4a	
				IRC 5	L
		Non-Native Aquatic Plants	Introduction of Non-native Organisms	IRC 4b	
040404	FWP	Dissolved Oxygen	On-site Treatment Systems	IRC 5	L
		Non-Native Aquatic Plants	Introduction of Non-native Organisms	IRC 4b	
	PCR	Fecal Coliform	On-site Treatment Systems	IRC 5	H
040602	FWP	Non-Native Aquatic Plants	Introduction of Non-native Organisms	IRC 4b	

Both historical 305(b) and current 303(d) lists suggest primary study area water quality problems relate to hypoxia. As a further to this suggestion, in 2011 a TMDL report was prepared for the lower Amite River watershed (located just north of subsegments partially included in the study area) to address organic enrichment and low dissolved oxygen. Long-term water quality monitoring in the study area was conducted by the Louisiana Department of Environmental Quality (LDEQ). Water quality trends in the study area based on this water quality assessment would be expected to continue. In particular, low dissolved oxygen conditions in the Maurepas Swamps and increasing marine influence in the northern study area are expected to persist, while the historically most common suspected causes of impairment within the study area would continue to generate water quality problems in competition with management efforts to eliminate impairments. With project water quality is addressed in the EIS.

Climatology

Temperature

Records of temperature are available from "Climatological Data" for Louisiana, published by the National Climatic Data Center. The study areas can be described by using the normal temperature data observed at the Hammond, and Donaldsonville stations. These stations are shown in Table one below with the monthly and annual mean normals which are based on the period of 1991-2011. The average annual mean normal temperature is 59.4^{o}F, with monthly mean temperature normal varying from 81.9^{o}F in July to 48.7^{o}F in December.

Precipitation

Records of precipitation are available from “Climatological Data” for Louisiana, published by the National Climatic Data Center. Two stations in the Louisiana study have been used to show the rainfall data for the areas of Donaldsonville and Ponchatoula/Hammond. Both stations have normal precipitation records which are based on the period of 1991-2011. The average annual normal rainfall of the two stations is 58.14 inches. The wettest normal month is June with a monthly average of 6.48 inches. October is the driest normal month averaging 4.11 inches and Donaldsonville has the greatest day with 24.49 inches of rain falling in June 2001.

Geotechnical

Engineering included the preparation of earthwork stability templates, settlement and lift schedule predictions, preparation of schematic alignment layouts, schematic pump station layouts, and scoping level project cost estimates for the elimination of alternatives to determine a tentatively selected plan. Schematic earthwork templates and settlement and lift schedule predictions were also performed.

The process to complete the scoping level engineering started with the geotechnical evaluation of the different alignments. The geotechnical evaluation consisted of reviewing existing soil boring data, preparation of earthwork stability templates, T-Wall analysis, settlement predictions, additional lifts, and secondary settlement predictions.

Geotechnical data was used to develop soil design parameters for the proposed alignments. At the time of the geotechnical report, four alternative alignments (reduced to three in August 2012) were being considered for the project. These alignments are denoted as Alignments A, C and D. Eighty three borings have been utilized for this screening study, with 23 geologic reaches and eleven soil reaches being developed. The alignments and reaches, as well as the developed soil design parameters, are shown in tabular and graphical form in the Draft Geotechnical Report Appendix I from March 2012 (which is available upon request).

Of the 83 borings furnished, 32 borings are located on Alignment A from its western limit at Hope Canal to its intersection with I-10 west of Highway 3188. These 32 borings comprise Soil Reaches 1 through 5. An additional 17 borings are located on the portion of Alignment A which coincides with I-10 from Highway 3188 to just west of the intersection with I-55 and comprise Soil Reaches 6 and 7. Thus, over half of the available data and selected reaches coincide with Alignment A.

The proposed alignments from the I-55 interchange to the St. Charles Parish line vary among the furnished drawings. For the purposes of this study, Alignment A is referenced as Alignment A in the geologic descriptions and reaches. Alignments C and D should be considered to coincide with Reach A in this area. Soil Reaches 8 through 10 were developed from the 27 borings in this area. However, as noted, these borings may not coincide with any or all of the current alignments.

Two of the available borings were utilized to define Soil Reach 11 at Mississippi Bayou. The remaining three borings were included with Soil Reach 1, but these borings coincide with Alignment C along the western side of the project.

Geotechnical data is not available for the portions of Alignments C and D which did not coincide with Alignment A at the time of this study. It has been projected that anticipated geologies at these locations are based on available data and information.

It should be noted that the geotechnical investigation was limited for this preliminary screening phase and did not include any exploration. The alignment chosen for the tentatively selected plan (TSP), Alignment C, will require additional geotechnical data collection based on USACE's current policies and procedures for completing a feasibility study.

Methodology and Assumptions. The analyses consider the HSDRRS design guidelines dated 23 October 2007, with the geotechnical section as updated on 12 June 2008, although the scope does not include all cases required by this guideline. Required factors of safety and design cases are based on these guidelines. The HSDRRS design guidelines have been updated since issuance of the draft report. The scope of this study only includes an evaluation of Q-case parameters assuming eventual use of S-case parameters will be less restrictive.

Water Levels. Hydraulic design criteria were selected based on GFI in the form of preliminary hydrographic survey maps. The levees were evaluated using the water levels furnished for the future conditions anticipated for the year 2020. To include structural superiority, the floodwall analyses are based on water levels projected for the year 2070.

The scope of this alternative alignment screening level study included stability analyses by Spencer's Method for water at the project grade level (PGL), still water level (SWL) and low water level (LWL) at the levees. The scope did not include consideration of the Top of Levee (TOL), as this was not considered a critical design case for this alternative alignment screening level study. The scope for this study also did not include an evaluation of stability by the Method of Planes (MOP) analyses. Stability analyses for the structures only considered extreme water level (EWL) and SWL.

Stability Analyses. Stability of earthen levees for the 11 soil design reaches were evaluated. Five of these reaches were also evaluated with geotextile reinforcement to reduce the size of the berms. Nine structures (T-walls and gates) were also evaluated.

Levee Stability. The earthen levees generally consist of a 10-ft levee crown with 3 horizontal on 1 vertical (3H:1V) side slopes. Substantial stability berms on the flood side and protected side are required for Soil Reaches 6 through 10. For these reaches, the berms can be reduced with the addition of geotextile reinforcement. A tabular summary of the results along with a plate of the governing stability analysis results are provided in the Draft Geotechnical Report Appendix I from March 2012 (which is available upon request).

Structure Stability. The T-walls and gates are located within Soil Design Reaches 1, 8 and 11. The majority of the cases analyzed indicate the presence of an unbalanced load. A tabular summary of all the results along with a plate of the governing analyses are included in the Draft Geotechnical Report Appendix I from March 2012 (which is available upon request). In addition to stability analyses, estimates of allowable pile load capacity were also computed for each soil reach where structures will be located.

Underseepage Analysis for Levees. With large stability berms required for several levees and considering a predominantly clay foundation, levee underseepage potential is not a significant design concern for most of the design soil reaches. However, Soil Reach 11 identified channel fill that will require either a cutoff, relief wells or seepage berms. Detailed underseepage analyses will be required during final design of the TSP to meet the HSDRRS design guidelines. The final field investigation should consider the estimated locations of abandoned distributaries and channel fill. Additional measures may be required to ensure adequate factors of safety are maintained.

Underseepage Analysis for Structures. Underseepage of pile-supported T-walls was evaluated using the Lane's Weighted Creep Ratio (LWCR) method to establish the tip elevations for the sheet pile cutoff wall. The flow path was assumed only to be the penetration of the sheet pile and horizontal contacts were not assumed. The sheet pile tip embedments are governed by seepage instead of the HSDRRS requirement of 5 feet of penetration below the critical failure plane (for unbalanced load cases).

Settlement Analyses. Settlement analyses were performed for Soil Reaches 1, 4, 6 and 10. An evaluation of the time-rate of consolidation settlement was not conducted; however, estimates for lift construction are available.

In general, settlement parameters for all reaches considered the surficial natural levee deposits and underlying Pleistocene deposits as precompressed. In addition, based on the available data, the swamp deposits were modeled to have an over consolidation ratio (OCR) between 3 and 10 in Soil Reaches 1 and 4 and between 1 and 2 in Soil Reaches 6 and 10. The interdistributary clays were typically modeled as normally consolidated. These values were based on the available boring data and correlations of moisture content to compression ratio (CR) values developed in the region. The parameters generally only consider the stress history at the available boring locations. The stress history at alignments away from the boring data was not assumed.

The higher OCR values in the swamp deposits may only be applicable to previously developed areas in Alignment A. Thus, even in Soil Reach 1, additional lifts may be needed to maintain the levee height in previously undeveloped areas along Hope Canal and along Alignment C. Due to the shallow depth of the Pleistocene interface on the western side of the project, additional fill height would be anticipated to be low. However, moving eastward along the project as the Pleistocene interface increases in depth, the potential for lift construction would increase. Further, it appears current alignments diverge from developed areas east of the I-10/I-55 interchange, increasing this potential even further.

Based on the parameters developed for Soil Reaches 1 and 4, a minimum of 1.5-ft overbuild was assumed in all of the levee stability analyses. The overbuild height for Soil Reach 1 did not require consideration of submergence. Submergence was considered for Soil Reach 4. Settlements greater than 1.5 feet were computed for Soil Reaches 6 and 10 where larger berms and/or greater fill heights would be required. Thus, lift construction will be required for these reaches to maintain the design grade.

The greatest levee height and greatest settlement were computed for Soil Reach 10. This soil reach also has the deepest Pleistocene interface. For Soil Reach 10, an overbuild height of 2.6 feet was computed. It was estimated an additional 3 inches of settlement would occur for this overbuild once the initial levee is fully consolidated. This resulted in a total overbuild of approximately 3 feet. It was determined that only one additional lift thickness be assumed and this lift may be considered as 1.5 feet with an initial overbuild of 1.5 feet. It was also decided that this lift schedule be assumed for Soil Reaches 8, 9 and 10. Based on calculations for Soil Reach 6, it was estimated the overbuild would need to be increased from 1.5 feet to 2.5 feet. Thus, a 1-ft lift thickness beyond the initial 1.5-ft overbuild should be assumed. This lift thickness was applied to Soil Reaches 6 and 7. No lift schedule is deemed necessary for Soil Reaches 1 through 4 and 11 on Alignment A.

The furnished hydraulic data is based on a design year of 2020. The design levee heights were considered to occur from 2012 to 2020. This is a relatively short design period. Therefore, only one construction lift was assumed to be feasible. It was determined that this lift be estimated to occur halfway through the design period or four years into the eight-year design. Given the limited data for this screening study, only assumed time-rate of settlement parameters could be developed. However, even these assumptions would not address the stress history and time-rate away from the boring locations. For alignments within previously undeveloped areas, an additional lift or increased lift thickness may be required.

Additional detailed geotechnical data and analyses (including updated information from May 2013) is available upon request.

Datum and Topography

The furnished soil borings and the soil parameter plots are referenced to NGVD. These elevations were reduced by 1 foot for conversion to the NAVD88 datum. Water levels were provided in NAVD88. All the analyses for this feasibility report reflect the NAVD88 datum. Topographic survey data was not obtained for the alternative alignments. Review of available Lidar data indicated average grade at Elevation 1.0 NAVD88 should be used for the analyses of the levees. While the ground elevation varies along the length of each alignment, the assumed ground elevation of 1.0 NAVD88 was appropriate for the majority of the alignment and conservative for the areas of higher ground elevation. With the exception of furnished gate elevations, average grade at Elevation 1.0 was also used for the typical T-wall analyses.

Civil/Structural Design

Three alternatives were evaluated for scoping level engineering: Alignment A, Alignment C and Alignment D. Prior to the scoping level engineering, the alignments consisted of non-dimensional generalized locations on large scale mapping. The purpose of the scoping level engineering was to refine the generalized alignment locations into levee cross sections coordinated with existing topography features (streams, channels, wetlands, etc.) and existing infrastructure (highways, pipelines, utilities, etc.).

After the levee templates were completed, it was decided to apply the design templates to Alignments A, C and D.

A set of standard details was prepared to provide a schematic elevation view of the typical pump station T-Wall, Interstate T-Wall, Roadway/Railroad Floodgate T-Wall and Pipeline T-Wall. These typical elevations included clearance recommendations from the geotechnical engineers to ensure the new construction would not adversely impact existing infrastructure. Drawings showing the typical elevations are available upon request.

The pump station flow rates and gravity drainage gate sizes were computed. These pump station flow rates and gravity drainage gate sizes were based upon hydrologic units defined in the existing SWMM model. If multiple drainage outfalls existed in the hydrologic unit, the projected pump station flows and gravity drainage gate sizes were divided based upon the percentage of the outfall's contributory area in the delineated hydrologic unit. The pump stations were grouped into twelve types based upon the pump and gate sizes. Typical Floor Plans were developed for each pump station type. These typical floor plans and a typical elevation through the station are available upon request.

A "smoothed" version of **Alignment A** (Figure 1) was used in order to minimize the encapsulation of wetlands in the protection system. Alignment A begins at the Upper Guide Levee of the Bonnet Carre' Spillway and travels westerly parallel to an existing pipeline corridor, around the Interstate 10/Interstate 55/US Highway 51 interchange, then follows Interstate 10 to the LA 3188 (Belle Terre Boulevard) interchange, then southerly and westerly paralleling the wetland wet/dry line to Mt. Airy where it terminates at the Mississippi River levee. The "smoothed" alignment was placed on the DOQQ base map and adjusted in a few minor locations. These locations included the Interstate 10 crossing east of the LaPlace interchange, the Interstate 55 crossing north of the US Highway 51 entrance ramp, the Interstate 10 crossing west of the Belle Terre interchange, and the existing water tower adjacent to the Belle Terre interchange. The modifications at the Interstate crossings were performed to cross the elevated structures with a ninety degree crossing that will ultimately be passed between existing bridge bents with a T-Wall. The Interstate 55 crossing was moved north to include the entrance/exit ramps from US Highway 55 and provide access for evacuation and recovery.

The top of levee elevation (net elevation) for this alignment is El. 13.5 NAVD88 (based on providing 100-Year protection in the Baseline Year of 2020), then decreases to El. 13.2 NAVD88 (at approx. Baseline Station 421+00), then decreases to El. 11.5 NAVD88 (at approx. Baseline Station 552+00), then decreases to El. 10.5 NAVD88 (at approx. Baseline Station 614+00), then decreases to El. 10.0 NAVD88 (at approx. Baseline Station 700+00), then decreases to El. 9.0 NAVD88 (at approx. Baseline Station 821+00) and finally decreases to El. 7.0 NAVD88 (at approx. Baseline Station 1013+00). The levee design, which involves the placement (in 2 lifts, 5 years apart) of approx. 3.1 million cubic yards of compacted and uncompacted clay fill, on top of 3.7 million square yards of geotextile fabric (with a 70-ft. width) along with a 100-ft. base width, 3:1 side slopes and 10-ft. crown width, creates a footprint of 411 acres. An aggregate limestone road (6 ft. wide x 8 in. thick) sits on top of the levee crown, a total of 29,615 cubic yards.

The design levee templates were placed along the proposed Alignment A at the defined soil and hydraulic reaches and based upon the recommended offsets for future maintenance activities, impacts to existing pile supported structures, offsets for stability from potential excavations (pipeline rights-of-way) and existing drainage features. Special attention was made to locate the right-of-way limits for the proposed levee sections to coincide with the existing rights-of-way from highways, pipelines etc. to avoid remainder parcels that were nonfunctional to the original owner. After the earthen embankments were placed on the base map and transitions performed from template section to template section, Alignment A was evaluated for specialty locations such as pump stations, T-Walls, gates, ramps, and pipeline crossings. The typical elevation details described above were utilized at appropriate locations and widths adjusted based upon the pump station size, Interstate crossing width, roadway/railway width, number of pipelines, etc. Alignment A was approximately 107,800 feet (20.41 miles) long and included 4,774 feet of T-Wall, 240 feet of drainage gates, 1,218 feet of roadway gates, two railway gates, seventy pipeline crossings, and eight pump stations. Schematic plans and typical levee sections (first and second lifts) were developed for Alignment A with levee template section, pump station, gate, T-Wall and pipeline crossings annotated. These schematic plans and typical levee sections are available upon request.

Alignment C (the TSP) begins at the Upper Guide Levee of the Bonnet Carre' Spillway and travels westerly parallel to an existing pipeline corridor, around the Interstate 10/Interstate 55/US Highway 51 interchange, then follows the existing pipeline corridor to Interstate 10/LA 3188 (Belle Terre Boulevard) interchange, then southerly and westerly paralleling the existing pipeline corridor to Mt. Airy where it terminates at the Mississippi River levee. Alignment C was developed to minimize the number of pipeline crossings.

The top of levee elevation (net elevation) for this alignment is El. 13.5 NAVD88 (based on providing 100-Year protection in the Baseline Year of 2020), then decreases to El. 13.2 NAVD88 (at approx. Baseline Station 304+00), then decreases to El. 12.2 NAVD88 (at approx. Baseline Station 354+00), then decreases to El. 10.2 NAVD88 (at approx. Baseline Station 612+00), then decreases to El. 9.0 NAVD88 (at approx. Baseline Station 722+00), then decreases to El. 7.5 NAVD88 (at approx. Baseline Station 905+00) and finally decreases to El. 7.0 NAVD88 (at approx. Baseline Station 968+00). The levee design, which involves the placement (in 2 lifts, 5 years apart) of approx. 3.1 million cubic yards of compacted and uncompacted clay fill, on top of 3.4 million square yards of geotextile fabric (with a 70-ft. width) along with a 100-ft. base width, 3:1 side slopes and 10-ft. crown width, creates a footprint of 856 acres. An aggregate limestone road (6 ft. wide x 8 in. thick) sits on top of the levee crown, a total of 26,124 cubic yards. A conveyance canal is situated along the entire levee (with a bottom depth elevation of El.-10 ft. NAVD88).

The design levee templates were placed along the proposed Alignment C at the defined soil and hydraulic reaches and based upon the recommended offsets for future maintenance activities, impacts to existing pile supported structures, offsets for stability from potential excavations (pipeline rights-of-way) and existing drainage features similar to Alignment A. There was a section of Alignment C from the Interstate 10/LA 3188 (Belle Terre Boulevard) interchange to the Mt. Airy community where there were no soil boring data and design levee templates were not developed. The other alignment's design levee templates that were in the closest proximity of the required hydraulic reach defined were used. Special attention was made to locate the right-of-way limits for the proposed levee sections to coincide with the existing rights-of-way from highways, pipelines etc. to avoid remainder parcels that were nonfunctional to the original owner. Once all the required design levee templates were selected for the hydraulic reaches, the levee sections were transitioned together similar to Alignment A. Alignment C was evaluated for specialty locations such as pump stations, T-Walls, gates, ramps and pipeline crossings.

Alignment C was approximately 96,500 feet (18.27 miles) long and included 5,304 feet of T-Wall, 2080 feet of drainage gates, 288 feet of roadway gates, two railway gates, thirty-six pipeline crossings, and four pump stations. Schematic plans and typical levee sections (first and second lifts) were developed for Alignment C with levee template section, pump station, gate, T-Wall and pipeline crossings annotated. These schematic plans and typical levee sections are available upon request.

Alignment D begins at the Upper Guide Levee of the Bonnet Carre' Spillway and travels westerly parallel to an existing pipeline corridor, around the Interstate 10/Interstate 55/US Highway 51 interchange, then follows the existing pipeline corridor to Interstate 10/LA 3188 (Belle Terre Boulevard) interchange, then westerly paralleling the Interstate 10 right-of-way approximately to the St James/Ascension Parish line, then turns northerly through the McElroy Swamp to the New River Canal, then westerly to the Marvin Braud Pump Station levee. Alignment D was developed to provide flood protection to the maximum number of communities in St Charles, St. John the Baptist, St. James, and Ascension Parishes and protect the Interstate 10 corridor. Alignment D also minimizes the number of pipeline crossings.

The top of levee elevation (net elevation) for this alignment is El. 13.5 NAVD88 (based on providing 100-Year protection in the Baseline Year of 2020), then decreases to El. 13.2 NAVD88 (at approx. Baseline Station 305+00), then decreases to El. 12.2 NAVD88 (at approx. Baseline Station 354+00), then decreases to El. 10.2 NAVD88 (at approx. Baseline Station 600+00), then decreases to El. 9.5 NAVD88 (at approx. Baseline Station 750+00) and finally decreases to El. 8.0 NAVD88 (at approx. Baseline Station 940+00). The levee design, which involves the placement (in 2 lifts, 5 years apart) of approx. 3.8 million cubic yards of compacted and uncompacted clay fill, on top of 3.1 million square yards of geotextile fabric (with a 70-ft. width) along with a 100-ft. base width, 3:1 side slopes and 10-ft. crown width, creates a footprint of 1,181 acres. An aggregate limestone road (6 ft. wide x 8 in. thick) sits on top of the levee crown, a total of 36,880 cubic yards. A conveyance canal is situated along the entire levee (with a bottom depth elevation of El.-10 ft. NAVD88).

The design levee templates were placed along the proposed Alignment D at the defined soil and hydraulic reaches and based upon the recommended offsets for future maintenance activities, impacts to existing pile supported structures, offsets for stability from potential excavations (pipeline rights-of-way) and existing drainage features similar to Alignments A and C. There was a section of Alignment D from the Interstate 10/Hope Canal crossing to the Marvin Braud levee where there were no soil boring data and design levee templates were not developed. The other alignment's design levee templates that were in the closest proximity of the required hydraulic reach defined were used. Special attention was made to locate the right-of-way limits for the proposed levee sections to coincide with the existing rights-of-way from highways, pipelines, etc. to avoid remainder parcels that were nonfunctional to the original owner. Once all of the required design levee templates were selected for the hydraulic reaches, the levee sections were transitioned together similar to Alignments A and C. Alignment D was evaluated for specialty locations such as pump stations, T-Walls, gates, ramps and pipeline crossings.

Alignment D was approximately 149,300 feet (28.28 miles) long and included 4,011 feet of T-Wall, 396 feet of drainage gates, 306 feet of roadway gates, no railway gates, fourteen pipeline crossings, and six pump stations. Schematic plans and typical levee sections (first and second lifts) were developed for Alignment D with levee template section, pump station, gate, T-Wall, and pipeline crossings annotated. These schematic plans and typical levee sections are available upon request.

Quantities. Quantities were computed for clearing and grubbing, geotextile, earthwork, aggregate roadway, turf establishment, T-Walls, drainage gates, roadway gates, railroad gates, pump stations and pipeline relocations.

Clearing and grubbing was based upon the proposed levee right-of-way limits denoted on the typical levee sections for the length of the reach and converted to acres. Geotextile was based upon the proposed width denoted on the typical levee sections for the length of the reach and converted to square yards. Earthwork was computed by end area denoted on the typical levee sections for the length of the reach. To determine the end area for each typical levee section, the average groundline elevation along the alignment centerline was computed. LIDAR data from the Louisiana State University Atlas Database was loaded into ArcGIS and the EZProfiler extension was used to obtain x, y, z, coordinates in Louisiana State Plane Coordinate System. The EZProfiler parameters were set to obtain coordinates and elevations every 45 feet along the alignment since the LIDAR data had 15 feet by 15 feet pixels. The EZProfiler dumped the coordinate and elevation data into an Excel spread, where the groundline elevation was averaged. The average groundline elevation was included in the levee typical section and the end areas were computed for each individual reach. After the end areas were computed, the length of the earthen levee segments were multiplied by the end area and ten by a 1.25 consolidation factor before converting into cubic yards. The 1.25 consolidation factor was used to account for consolidation and compaction of underlying existing soils as the new earthwork lifts are performed. Turf establishment quantities were set equal to the clearing and grubbing limits and converted to acres. Aggregate road surfacing was computed from the levee segment length and a section 6 feet wide and 8 inch deep then converted to cubic yards. T-Walls, Drainage Gates, and Roadway Gates were tabulated by length and incremental wall heights. An incremental wall height of 5 feet was set as the criteria. Railroad gates were measured per each. Pipeline relocations were measured per each and the incremental pipeline size. Incremental pipeline sizes were set at less than or equal to 6 inches, greater than 6 inches up to 12 inches, greater than 12 inches up to 18 inches, greater than 18 inches up to 24 inches and greater than 24 inches. All quantities for Alignments A, C and D were computed in the same manner.

Relocations

An ArcGIS State of La. Oil Spill Response Database was used to identify the pipeline locations for each alignment. This database contained not only the shapefiles of the pipelines but in most instances the owner, size, type and the carried material. This data was used for each of the three alignments. The assumption for each alignment was that a pipeline floodwall would be required wherever a pipeline crossed the levee footprint. The pipeline would cross through the pipeline floodwall. It was decided that the existing carrier line would remain in operation while a bypass line would be constructed through a sleeve in the T-wall cutoff piles. When the bypass would be complete and in place, the switch over-tie in with the existing line then would follow. A unit cost for the different pipe size ranges was used (unit costs were furnished by USACE). See below.

Pipeline Relocations

Description	Estimated Quantity (Q)	Units	Unit Cost (UC)
≤6" Diameter	14	Each	$515,000
>6" to ≤12" Diameter	16	Each	$700,000
>18" to ≤24" Diameter	5	Each	$1,550,000
> 24" Diameter	1	Each	$1,920,000

Detailed information (including identification of pipeline owners, sizes and product carried through the line) is available upon request.

Cost Estimates

After each alignment's quantities were finalized, cost estimates were prepared for each alignment. For each item, the item description, item quantity, unit of measure, unit cost, item cost, contingency and total item cost was tabulated in an Excel spreadsheet; the same information was later prepared in MII MCACES format. Since the unit of measure for the pump stations was set by the cubic feet per second (cfs) flow rate of each type of pump station, separate quantities and costs were computed for each type of pump station. Separate tabs for each pump station were created in the Excel spreadsheet (and subsequently shown in the MII MCACES format for each alignment). The cost for each pump station was divided by the flow rate to determine the unit cost. All cost estimates for Alignments A, C and D were computed in the same manner. See Table 2 below for Estimated Cost Summary of each alignment.

Table 3: Estimated Total Cost (For Each Alignment)

Item	Alignment A	Alignment C (TSP)	Alignment D
Levees & Floodwalls	$335,898,670	$334,156,997	$339,508,346
Pump Stations	$132,162,500	$112,687,500	$166,437,500
Pipeline Relocations	$70,300,000	$35,100,000	$11,693,750
Real Estate	$3,849,000	$3,283,000	$2,434,000
Direct Habitat Impacts	$17,000,791	$35,710,811	$43,323,364
Indirect Mitigation Costs (15%)	$23,123,679	$54,655,968	$327,687,626
Non-Structural Measures (Year 2070)	$305,256,794	$305,256,794	$0
TOTAL COST (Including Non-Structural Measures)	**$887,591,434**	**$880,851,070**	**$891,084,586**

References

ER 1110-2-1150, Engineering and Design for Civil Works Projects, 31 August 1999.

ER 1110-1-8159, Engineering and Design, DrChecks, 10 May 2001.

ER 1110-1-12, Engineering and Design, Quality Management, 21 July 2006.

EC 1165-2-209, Civil Works Review Policy, 31 January 2010.

EC 1165-2-214, Civil Works Review Policy, 15 December 2012.

EC 1165-2-212, Sea Level Change Considerations for Civil Works Programs, 01 October 2011.

Hurricane and Storm Damage Reduction System (HSDDRS), Design Guidelines, USACE, New Orleans District, June 2008.

CECW-CE, Engineering and Construction Bulletin, No. 2004-13, Issued 30 Aug 2004.

EM 1110-2-6056, Standards and Procedures for Referencing Project Elevation Grades to Nationwide Vertical Datums, 31 December 2010.

USACE New Orleans District Guide for Minimum Survey Standards for Performing Topographic, Hydrographic, and Static GPS Control Surveys (Edition 2.1).

Louisiana State Plane Coordinate System South Zone (1702) using North American Datum of 1983 (NAD83) for horizontal datum.

North American Vertical Datum of 1988 Epoch 2004.65 (NAVD88-2004.65) for vertical datum.

ER 1110-1-12, Engineering and Design, Quality Management, dated September 30, 2005.

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

REAL ESTATE PLAN
APPENDIX C

Contents

PURPOSE OF THE REAL ESTATE PLAN

This Real Estate Plan (REP) presents the real estate requirements and costs for the Feasibility Report for the West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Project (WSLP). The information contained herein is tentative in nature for planning purposes only. At the time the REP was prepared, the Project Delivery Team (PDT) had reached the TSP milestone, and feasibility level analysis was just beginning. Footprint maps which identify locations of access, staging, borrow and other project features were not available. The information contained within this REP is based on assumptions made by the PDT, and estimated acreages of project features. This REP does not fully conform to the requirements of Chapter 12 (ER 405-1-12). Once feasibility level analysis is complete, the REP will be revised to conform with Chapter 12.

PROJECT DESCRIPTION AND LOCATION

The project is a hurricane and storm damage reduction study based on ER 1105-2-100. The project purpose is to assess the needed hurricane storm damage risk reduction measures in portions of St. Charles, St. John the Baptist, and St. James Parishes.

The project is located within portions of St. Charles, St. John the Baptist, and St. James Parishes, Louisiana. It is bounded on the east by the Bonnet Carré Spillway upper guide levee, on the north by Lakes Pontchartrain and Maurepas, on the west by the Ascension/St. James Parish line, and on the south by the Mississippi River Levee (MRL) (Figure 1-1).

Figure 1: Study Area

The tentatively selected plan (TSP) lies between the West Guide levee of the Bonnet Carré Spillway to the US-51 interchange, where it tracks north across US-51 and along a pipeline corridor. At I-10 near the Belle Terre exit, the tentatively selected plan crosses the interstate and follows the pipeline corridor through wetlands until it reaches the St. John the Baptist and St. James Parish line. At that point, the alignment turns south and extends to the location where the ground elevation is equal to or higher than the levee design crest elevation (near the MRL). Figure 1-2 below shows the alignment of the TSP with respect to the project area, and maps showing a more detailed view of the TSP alignment are located within Exhibit A (maps C1 thru C8). This Alternative will also implement non-structural measures which include elevation of structures and acquisition of structures in the western portion of the study area in the communities of Gramercy, Lutcher and Grand Point.

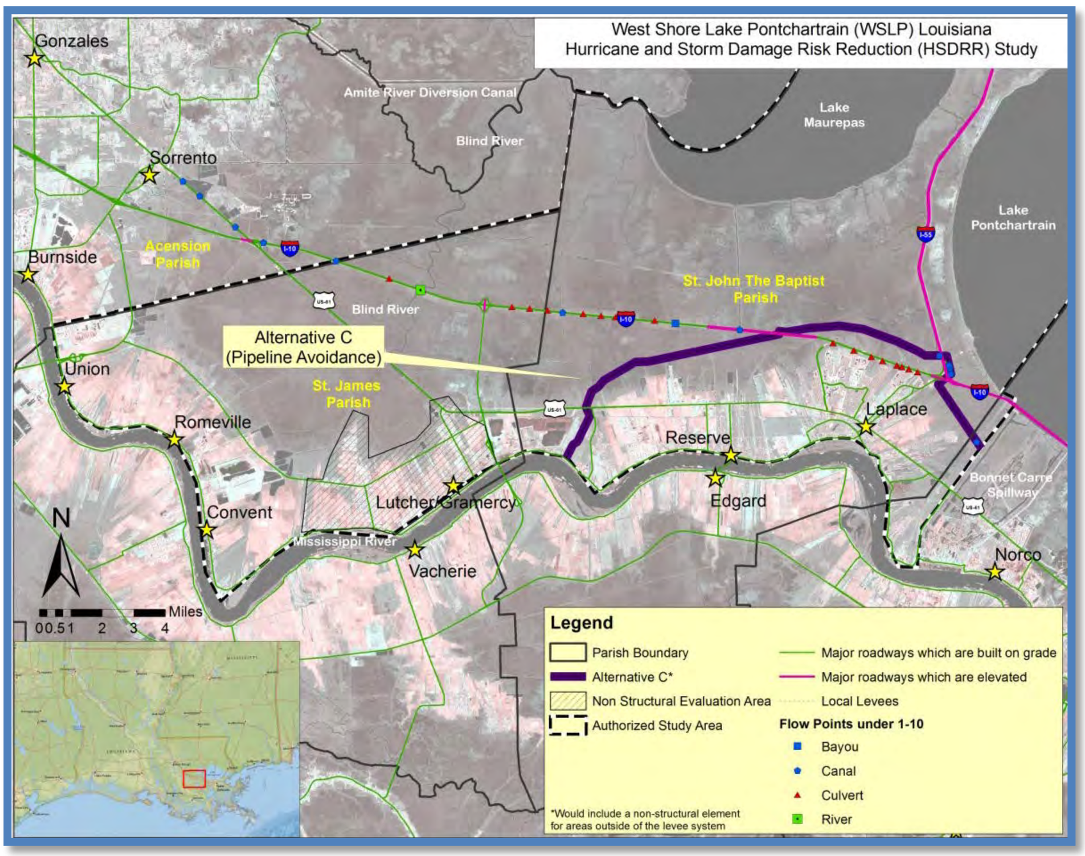


Figure 2: TSP Alignment

The TSP alignment consists largely of earthen levees, but does contain T-walls for crossings of roadways and pipelines. Based on the preliminary level of design, levee elevations would range from +13.5 NAVD88 on the eastern reaches near the Bonnet Carré Spillway to +7.0 NAVD88 in the western portion of the project area. Approximately 26,124 cubic yards of aggregate limestone would be used to build a road on the levee crown for operation and maintenance purposes. A conveyance canal at a depth of -10 ft. NAVD88 would be situated adjacent to the levee. The alignment is approximately 18.27 miles and includes 5,304 feet of t-wall, 208 feet of drainage gates, 288 feet of roadway gates, two railway gates, 36 pipeline crossings and four pump stations. In addition, this Alternative will implement non-structural measures which include elevation of structures and acquisition of structures in the western portion of the study area in the communities of Gramercy, Lutcher and Grand Point.

PROJECT AUTHORIZATION

Two Congressional resolutions authorize the Study. The first was adopted on July 29, 1971, by the U.S. House of Representatives Committee on Public Works. The resolution reads:

> *"RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE HOUSE OF REPRESENTATIVES, UNITED STATES, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report of the Chief of Engineers on Lake Pontchartrain and Vicinity, Louisiana, published as House Document No. 231, 89th Congress, First Session, and other pertinent reports, with a view to determining whether modifications to the recommendations contained therein are advisable at this time, with particular reference to providing additional levees for hurricane protection and flood control in St. John the Baptist Parish and that part of St. Charles Parish west of the Bonnet Carré' Spillway."*

The second resolution was adopted by the U.S. Senate Committee on Public Works on September 20, 1974. The resolution reads:

> *"RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, that the Board for Rivers and Harbors is hereby requested to review\ the report of the Chief of Engineers on Lake Pontchartrain and Vicinity, Louisiana, published as House Document No. 231, 89th Congress, First Session, and other pertinent reports, with a view to determining whether modifications to the recommendations contained therein are advisable at this time, for hurricane protection and flood control in St. James Parish."*

NON-FEDERAL SPONSOR

In 1998, the USACE and the Pontchartrain Levee District (PLD) executed a Feasibility Cost Sharing Agreement and Project Study Plan for the study. An amendment was executed in 2008. The Louisiana Coastal Protection Restoration Authority Board (CPRAB), will be required to serve as the Non-Federal Sponsor (NFS) for construction and Operation, Maintenance, Repair, Rehabilitation and Replacement (OMRR&R) if this project is authorized.

The Coastal Protection and Restoration Authority Board (CPRAB) is an agency for the State of Louisiana that was created by LA Act 8 (2005) for multiple purposes, one of which is the provision of hurricane storm damage risk reduction measures. The Coastal Protection and Restoration Authority (CPRA), also a State agency, is the implementing agency of CPRAB, which has been given the authority to acquire and hold these lands.

CPRAB, as the Non-Federal Sponsor, is charged with responsibility for the provision of all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; performing or ensuring the performance of all relocations; and constructing all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the project (LERRDs).

While CPRAB has condemnation authority, it does not, at this time, possess quick-take condemnation authority. If that condition continues when the Real Estate acquisition process commences, CPRAB will have to reach agreement with another state agency that has quick-take condemnation authority in order to have that agency perform any quick-take condemnation measures on behalf of CPRAB that may be necessary for construction of the project.

Assessment of the Non-Federal Sponsor's Real Estate Acquisition Capability for CPRAB is attached as Exhibit B. The Non-Federal Sponsor has been found to be fully capable of performing acquisition of the LER required for the project, conditioned upon its obtaining quick-take condemnation authority in the future or its ability to enter into a Cooperative Endeavor Agreement with a state agency that has quick-take condemnation authority.

LANDS, EASEMENTS & RIGHTS-OF-WAY

The TSP structural alignment primarily impacts wetlands. A large portion of the project alignment lies within state owned lands. An estimated 120 private landowners will be affected by this project feature.

The PDT worked to locate the right-of-way limits for the proposed levee sections to coincide with existing rights-of-way from highways, pipelines, etc. in order to avoid remainder parcels that were non-functional to the landowners.

The TSP alignment consists largely of earthen levees, but does contain T-walls for crossings of roadways and pipelines. Based on the preliminary level of design, levee elevations would range from +13.5 NAVD88 on the eastern reaches near the Bonnet Carré Spillway to +7.0 NAVD88 in the western portion of the project area. Approximately 26,124 cubic yards of aggregate limestone would be used to build a road on the levee crown for operation and maintenance purposes. A conveyance canal at a depth of -10 ft. NAVD88 would be situated adjacent to the levee. The alignment is approximately 18.27 miles and includes 5,304 feet of t-wall, 208 feet of drainage gates, 288 feet of roadway gates, two railway gates, 36 pipeline crossings and four pump stations.

This alternative will also implement a non-structural project feature, which includes elevation of an estimated 1,481 structures and acquisition of an estimated 90 structures. More detailed information regarding the non-structural features will be provided once feasibility level analysis is complete.

A standard perpetual levee easement will be acquired for the construction of the levee and T-walls as well as the right of way necessary for the gates associated with T-walls. A non-standard underground piling easement will also be acquired for the T-wall (this estate was approved by Headquarters in 2006 for the HSDRRS project and future floodwall projects, as shown in Exhibit F). A standard Drainage Ditch Easement will be acquired for the conveyance channel. A standard temporary work area easement will be acquired for staging areas. Mitigation areas will be acquired in fee, excluding minerals (with restrictions on use of surface). A non-material deviation will be made to the standard road easement to provide for the temporary, non-exclusive rights necessary for temporary access routes (refer to Exhibit D).

For state owned lands within the project alignment, the state will issue a Grant of Particular Use to the government. Refer to the section entitled "State Owned LER" below for more details regarding the Grant of Particular Use.

For the non-structural project features, the PDT has not performed detailed analysis on the acquisitions or elevations. At this time, there has not been sufficient evaluation to determine specific structures to be included in this feature. A detailed evaluation of the work entailed in structure raising will be accomplished during feasibility level design. At that time, appropriate real estate interests to be acquired for the non-structural features will be determined, and the real estate costs will be refined and included within the final REP. Full coordination will take place with the vertical team.

Table 1 below demonstrates the acreage, ownerships affected, and proposed estate for each project feature. This information is tentative in nature and will be revised following feasibility level design:

Table 1: Acreage

Project Feature	# Acres	# Tracts/Ownerships	Proposed Estate
Access	3	1*	Temporary Access Easement
Levee/T-wall	856	120	Perpetual Levee Easement/ Perpetual Underground Piling Easement
Conveyance Canal	**	120*	Drainage Ditch Easement
Gates	50	4*	Fee, Excluding Minerals
Pump Stations	5	4*	Fee, Excluding Minerals
Staging	TBD	TBD	Temporary Work Area Easement
Mitigation	774	TBD	Fee, Excluding Minerals
Nonstructural Acquisition		1571	TBD
Borrow	TBD		Refer to discussion of Borrow within LER descriptions below

**Landowners shown with an asterisk are assumed to be the same landowners that will be affected by the levee/t-wall features. Total estimated landowners affected by the structural features is 120.*
***Acreage for the conveyance canal is calculated within the acreage for the Levee/T-Wall. The Final REP will separate this acreage.*

Note: Acreages and number of ownerships above are estimates, and will be revised following feasibility level of design.

ACCESS

Access for construction of the project will be directly from the right-of-way of the Upper Guide Levee, US-51, US-61 and La. 44. No additional right-of-way will be required at these access points. One access point at Airport Road will require 3 acres of additional right-of-way. A Temporary Access Easement will be acquired for this portion of the project.

STAGING

The majority of staging areas for construction of this project will be located within the Right-of-Way for the levee footprint or existing Right-of-Way. Additional Right-of-Way will be required within a few reaches. Staging area locations and acreages for LER to be acquired will be determined during feasibility level design. A standard Temporary Work Area Easement will be acquired for the additional right-of-way required for this portion of the project.

BORROW

Borrow material for the project would come from the Bonnet Carré Spillway, which is owned in fee by the federal government, or from alternative borrow sources not yet identified. A borrow analysis will be prepared to identify potential borrow sources. The CPRAB will be required to acquire all LER for borrow.

MITIGATION

Alternative C (TSP) would directly impact a total of approximately 719 acres of wetlands including primarily forested wetlands/swamp along the reach of the alignment located north of US Highway 61, and approximately 55 acres of dry and/or wet BLH located along the reach of the alignment located south of US Highway 61.

The standard Fee, Excluding Minerals (With Restriction on Use of Surface) estate would be acquired for mitigation areas. The specific location of mitigation areas will be determined during feasibility level design.

It is anticipated that a large portion of the mitigation areas may fall within state owned lands.

INDUCED FLOODING

Modeling is currently underway as a part of feasibility level design. Pump stations will be used to drain the project area. These pump stations will be operated so that the construction of project features will not induce flooding on the protected side of the project. In the event that modeling results indicate there could be induced flooding outside the protected area, a takings analysis will be prepared and a determination will be made as to whether additional real estate interests need to be acquired.

NON-FEDERAL SPONSOR OWNED LER

Portions of the levee footprint and potential mitigation sites lie within lands owned by the State of Louisiana.

The State of Louisiana is prohibited by Constitutional mandate from granting easements over its property or selling the property in fee interest. The Grant of Particular Use is the instrument executed by the State which allows the Federal government to enter its property and construct the project (in Federal terms, this would be called Right-of-Entry). The document discusses the work to be performed on the land and the duration of occupancy. The state will issue a Grant of Particular Use for the project area which lies within state owned water bottoms. The rights delineated in the Grant of Particular Use issued by the State will be similar to the language in the standard perpetual levee easement.

The Non-Federal Sponsor will be notified in writing of the risks of acquiring LERRDs before execution of the PPA.

ESTATES

The following standard estates will be required for the project:

FEE EXCLUDING MINERALS (With Restriction on Use of the Surface)

The fee simple title to the land, subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines; excepting and excluding all (coal) (oil and gas), in and under said land and all appurtenant rights for the exploration, development, production and removal of said (coal) (oil and gas), but without the right to enter upon or over the surface of said land for the for the purpose of exploration, development, production and removal therefrom of said (coal) (oil and gas).

FLOOD PROTECTION LEVEE EASEMENT

A perpetual and assignable right and easement in (the land described in Schedule A) (Tracts Nos, ____, ____ and ____) to construct, maintain, repair, operate, patrol and replace a flood protection (levee) (floodwall)(gate closure) (sandbag closure), including all appurtenances thereto; reserving, however, to the owners, their heirs and assigns, all such rights and privileges in the land as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

DRAINAGE DITCH EASEMENT

A perpetual and assignable easement and right-of-way in, over and across (the land described in Schedule A) (Tracts Nos. ____, ____ and _____) to construct, maintain, repair, operate, patrol and replace a drainage ditch, reserving, however, to the owners, their heirs and assigns, all such rights and privileges in the land as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

TEMPORARY WORK AREA EASEMENT

A temporary easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. _____, _____ and _____), for a period not to exceed ___________________, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as a (borrow area) (work area), including the right to (borrow and/or deposit fill, spoil and waste material thereon) (move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the ____________________ Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, *structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.*

TEMPORARY ACCESS EASEMENT (Non-Material Deviation from Standard Estate)

A non-exclusive and assignable temporary easement for a period not to exceed _____years beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as an access route and/or right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. _____, _____ and _____); together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way, reserving, however, to the owners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired, including the right to cross over the right-of-way as access to their adjoining land; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

Approval of the Temporary Access Easement (Non-Material Deviation from Standard Estate) is attached as Exhibit D.

Perpetual Underground Piling Easement

Currently designed T-wall type floodwalls require a non-standard Perpetual Underground Piling Easement in addition to the standard Perpetual Flood Protection Levee/Floodwall Easement for construction, operation and maintenance. A copy of the Perpetual Underground Piling Easement which was approved in 2006 for HSDRRS projects and any future floodwall projects is attached as Exhibit E.

The typical T-wall type floodwall includes an underground battered piling supported foundation. To accommodate construction, a standard Perpetual Flood Protection Levee/Floodwall Easement will extend out from the centerline of the sheetpile floodwall, providing surface and underground rights to construct and maintain the floodwall, including the sheetpile wall and the initial segment of the underground support piles extending out from the sheetpile. A non-standard Perpetual Underground Piling Easement will allow for construction and maintenance of the remaining segment of the underground pilings that extend out beyond the outer limits of standard levee/floodwall easement on both the flood and protected sides of the floodwall. This underground easement will not unnecessarily restrict the surface use of these areas as would the standard Perpetual Flood Protection Levee/Floodwall Easement and will significantly reduce potential landowner relocations requiring payments for certain improvements (structures) and P.L. 91-646 Title II benefits. Avoiding unnecessary perpetual surface restrictions will preserve the ordinary surface rights of residential property owners. Acquiring the non-standard Perpetual Underground Piling Easement also adheres to the policy set forth in ER 405-1-12 (Section 12-9) of acquiring the minimum interest in real property necessary to support the project.

EXISTING FEDERAL PROJECTS WITHIN THE LER REQUIRED FOR THE PROJECT

Reintroduction of Mississippi River Water Into Maurepas Swamp Project (Hope Canal)

The project is located within the WSLP project alignment. However, the project is currently in the engineering and design phase, and no LERRDs have been acquired.

FEDERALLY OWNED LANDS WITHIN THE LER FOR THE PROJECT

Borrow material for the project would come from the Bonnet Carré Spillway, which is owned in fee by the federal government. USACE is the managing agency over this land.

NAVIGATION SERVITUDE

The navigation servitude is the dominant right of the Government under the Commerce Clause of the U.S. Constitution to use, control and regulate the navigable waters of the United States and submerged lands thereunder.

The project does not require LER within any navigable watercourses. Therefore, the Federal Navigational Servitude will not be invoked for this project.

BASELINE COST ESTIMATES/CHART OF ACCOUNTS (COAs)

A Chart of Accounts for the tentatively selected plan is included in Exhibit C of this Real Estate Plan. The estimated total cost for Real Estate Acquisition is $84,700,000. This includes $3,283,000 for the structural features and $81,417,000 for non-structural features.

The costs for structural features include land payments as well as administrative costs and incremental costs associated with acquiring the real estate interests, as well as costs for potential condemnations. Cost estimates will be revised after completion of feasibility level design.

Costs for the non-structural features are ROM level estimates which will be refined once the appropriate real estate interests are determined. Displaced persons and business may be entitled to relocation assistance benefits (P.L. 91-646, Title II as amended).

Because real estate costs did not exceed 10% of total project costs, a gross appraisal was not prepared for this project (refer to Real Estate Policy Guidance Letter Non. 31-Real Estate Support to Civil Works Planning Paradigm (3x3x3) dated January 10, 2013, attached as Exhibit G). LER costs are based on a cost estimate prepared by the Appraisal Branch in April 2013. It is noted that a large percentage of total estimated real estate costs include consideration of URA relocations costs, and the value of actual land to be acquired is well below 10% of total project costs.

Note: The cost estimates do not reflect the costs for facilities/utilities relocations. Refer to the section entitled "Facility/Utility Relocations" for more information.

UNIFORM RELOCATION ASSISTANCE (PL 91-646, Title II as amended)

Approximately 1,571 landowners may be impacted by the non-structural project features. Relocation assistance benefits to residents may be applicable, including storage of household goods, moving costs, lodging, incidentals, differential payments, etc. Businesses could be entitled to receive advisory services, reimbursement for actual reasonable moving costs, re-establishment costs which are capped at $10,000, and certain reasonable and necessary incidental costs associated with the relocation.

TIMBER/MINERAL/ROW CROP ACTIVITY

The Louisiana Department of Natural Resources provides a Strategic Online Natural Resources Information System (SONRIS), which contains up-to-date information on oil & gas activity in the state of Louisiana. Review of this information indicated that although there are oil and gas wells within the study area, there are no active wells within the projected TSP alignment. This information will be reviewed and confirmed following feasibility level design.

With the exception of the acquisition of the standard Fee Excluding Minerals (With Restrictions on the Use of the Surface) estate over certain lands which has the potential to impact mineral rights, the other estates have no impact on mineral rights and the Government will not acquire mineral rights to any of the LER required for the project. Over lands where the fee estate is being acquired, mineral rights will be subordinated. Mineral right owners can still explore for minerals through directional drilling.

There are approximately 80 acres of agricultural land impacted by the project. Any timber present is included in the overall appraised value of the land. For properties impacted by the project which are in agricultural use, the owner will be allowed to harvest crops prior to acquisition.

OYSTER LEASES

There are no oyster leases located within the project study area.

ZONING ORDINANCES

There will be no application or enactment of zoning ordinances in lieu of, or to facilitate, acquisition for structural features of this project. As the plans are developed for non-structural features during feasibility level design, it is possible that there will be certain building restrictions in areas where elevations or floodproofing measures are proposed, and in areas where there may be buy-out acquisitions.

ACQUISITION SCHEDULE

The following acquisition schedule for structural project features is based on the premise that the project will impact approximately 120 landowners for the levee alignment. It is assumed that the project will be constructed in sections. A detailed acquisition schedule will be prepared during PED once the 95% plans and specifications are prepared for each section of the project. The schedule below provides the total amount of time to complete the acquisition of real estate rights for mitigation and for the construction of the levee alignment and other project features based on the preliminary information available at this time. This schedule is only for purposes of the feasibility study, and will be updated following feasibility level of design.

1) TOD, Mapping	1 year
2) Obtain Title & Appraisals	2 years
3) Negotiations	4 years
4) Closing	2 years
5) Eminent Domain Proceedings	6 years

At this time, a schedule for non-structural project feature implementation has not been determined. This will be re-evaluated during feasibility level analysis.

FACILITY/UTILITY RELOCATIONS

Relocation data is collected and detailed by the USACE New Orleans District, Engineering Division, Design Services Branch Relocations Team. At the time of this report, information was not available to a feasibility level of analysis.

There are an estimated 36 pipeline relocations as part of the tentatively selected plan. A preliminary list of pipeline relocations is attached as Exhibit F. The estimated cost of pipeline relocations is $28,080,000.

Real Estate Guidance issued for 3x3x3 studies indicates that if the costs of relocation of facilities and utilities is less than 30% of project costs, a preliminary compensable interest report should not be prepared (refer to Real Estate Policy Guidance Letter Non. 31-Real Estate Support to Civil Works Planning Paradigm (3x3x3) dated January 10, 2013, attached as Exhibit G). Because the estimated cost of relocations does not exceed 30% of total project cost, an Attorney's Preliminary Opinion of Compensable Interest was not prepared for this project. Rather, once feasibility level of design is complete, a Relocations Report will be prepared and the Real Estate Plan will include a relocations assessment indicating which relocations are covered by the substitute facilities doctrine. A Final Attorney's Opinion of Compensability will be prepared once the PPA is signed.

A separate Relocations Report, containing relocations costs, will be submitted as a reference to the Engineering Appendix. Maps of potential relocations can be referenced in that appendix. Those relocation costs represent a preliminary level of design and will be further refined during the development of the project P&S.

The Non-Federal Sponsor will perform these relocations as a part of its responsibility under the project authority. The conclusions are preliminary only. The Government will make a final determination of the relocations necessary for the construction, operation or maintenance of the project after further analysis, and completion and approval of the Final Attorney's Opinion of Compensability for each of the impacted utilities and facilities.

HAZARDOUS, TOXIC AND RADIOACTIVE WASTE

At the time of this report, a Phase I Environmental Site Assessment has not been conducted. This assessment will be performed during feasibility level of design. Current information suggests there will be no HTRW issues within the project area.

LANDOWNER CONCERNS

The project has received wide-spread support from the community; however, the attitudes of the landowners who will be directly affected by its construction is not known. The Non-Federal Sponsor is confident that they will be able to acquire the LER required for the project. However, it is anticipated that there may not be strong landowner support for acquisition of properties outside the levee areas, should there be induced flooding.

Prepared By:

Karen E. Vance
Realty Specialist, Planning & Appraisal Branch
Real Estate Region South Division
August 14, 2013

Recommended for Approval By:

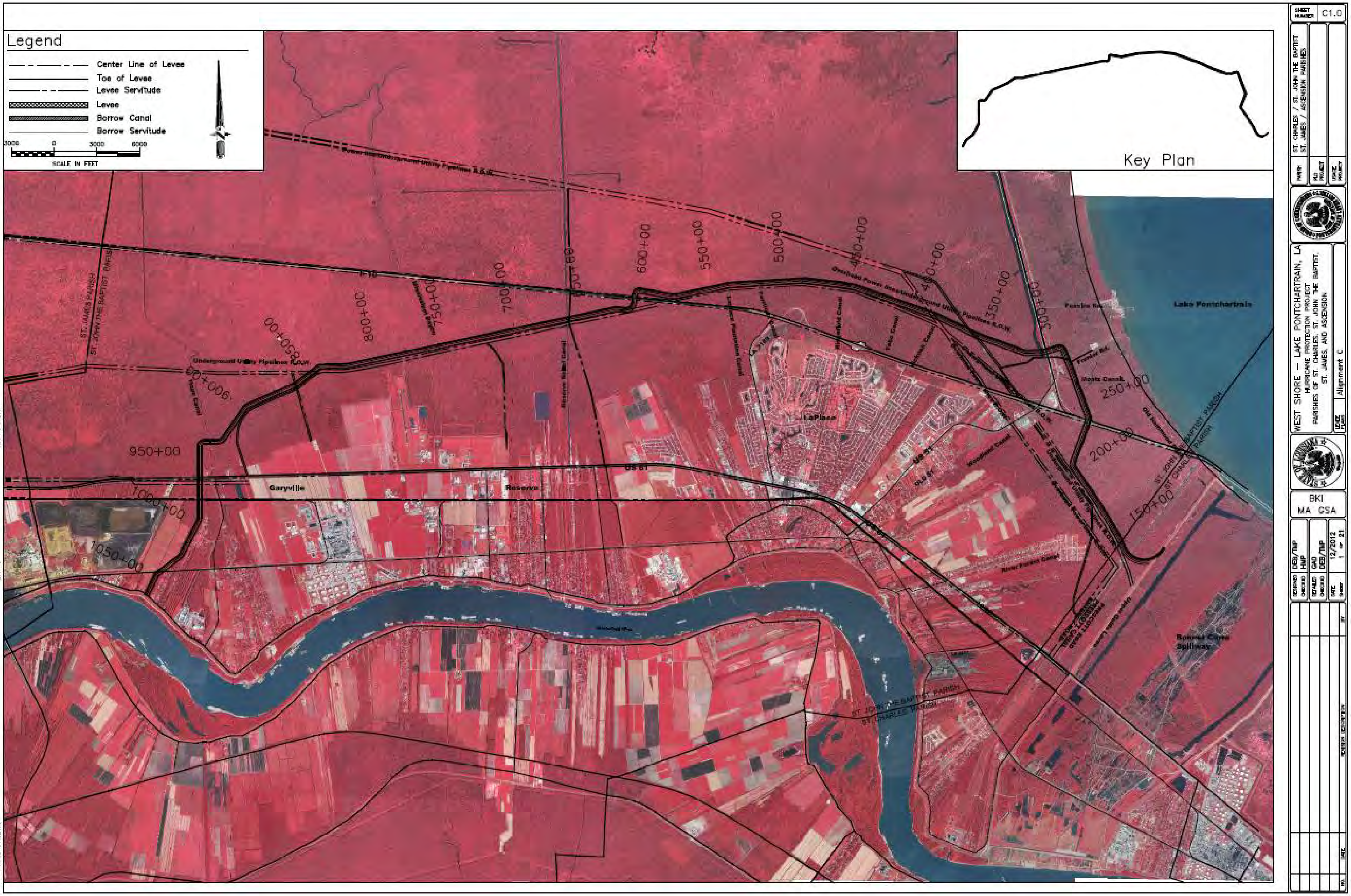
Judith Y. Gutierrez
Chief, Appraisal & Planning Branch
Real Estate Region South Division
August 14, 2013

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

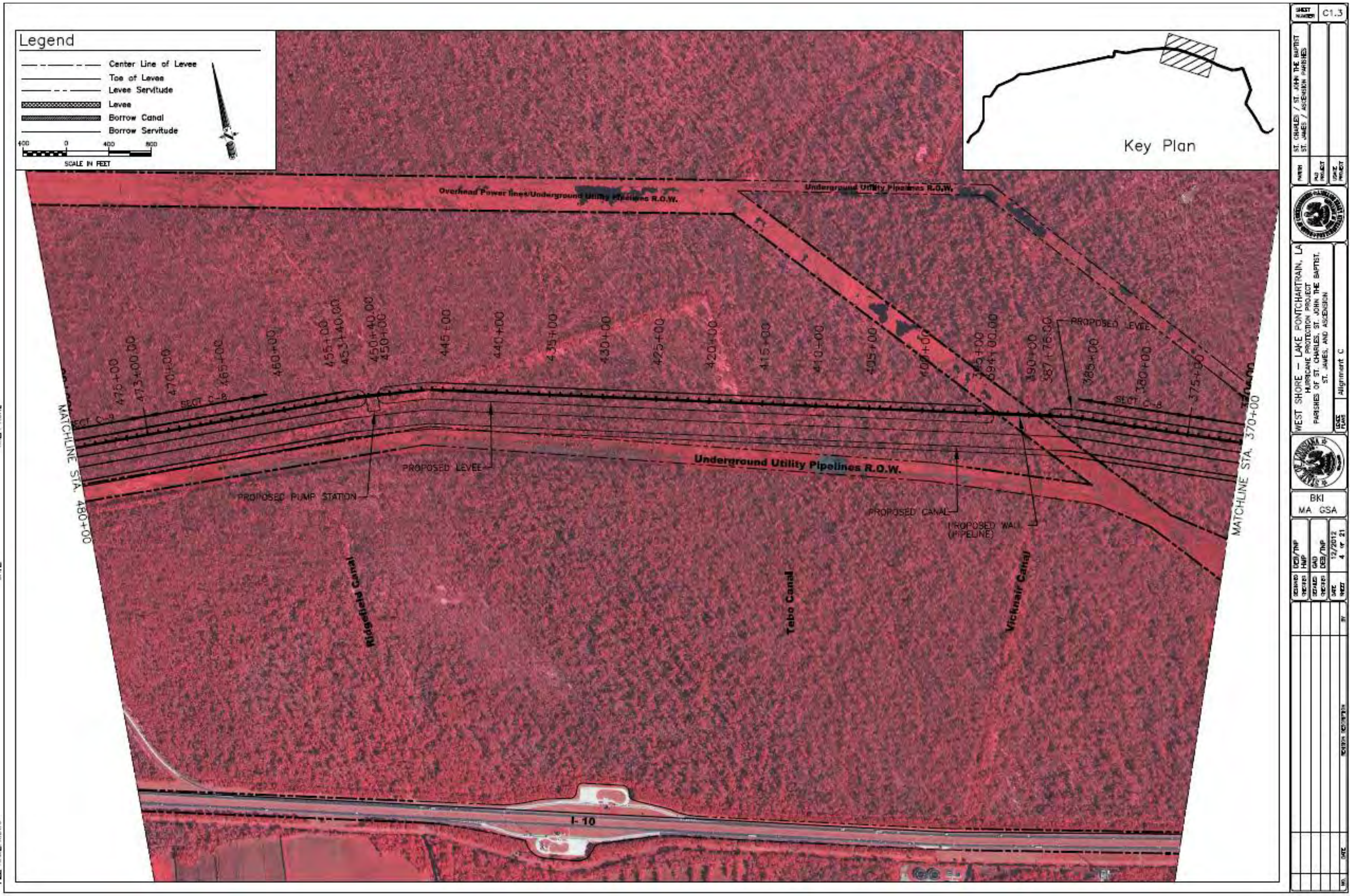
APPENDIX C

ANNEX A

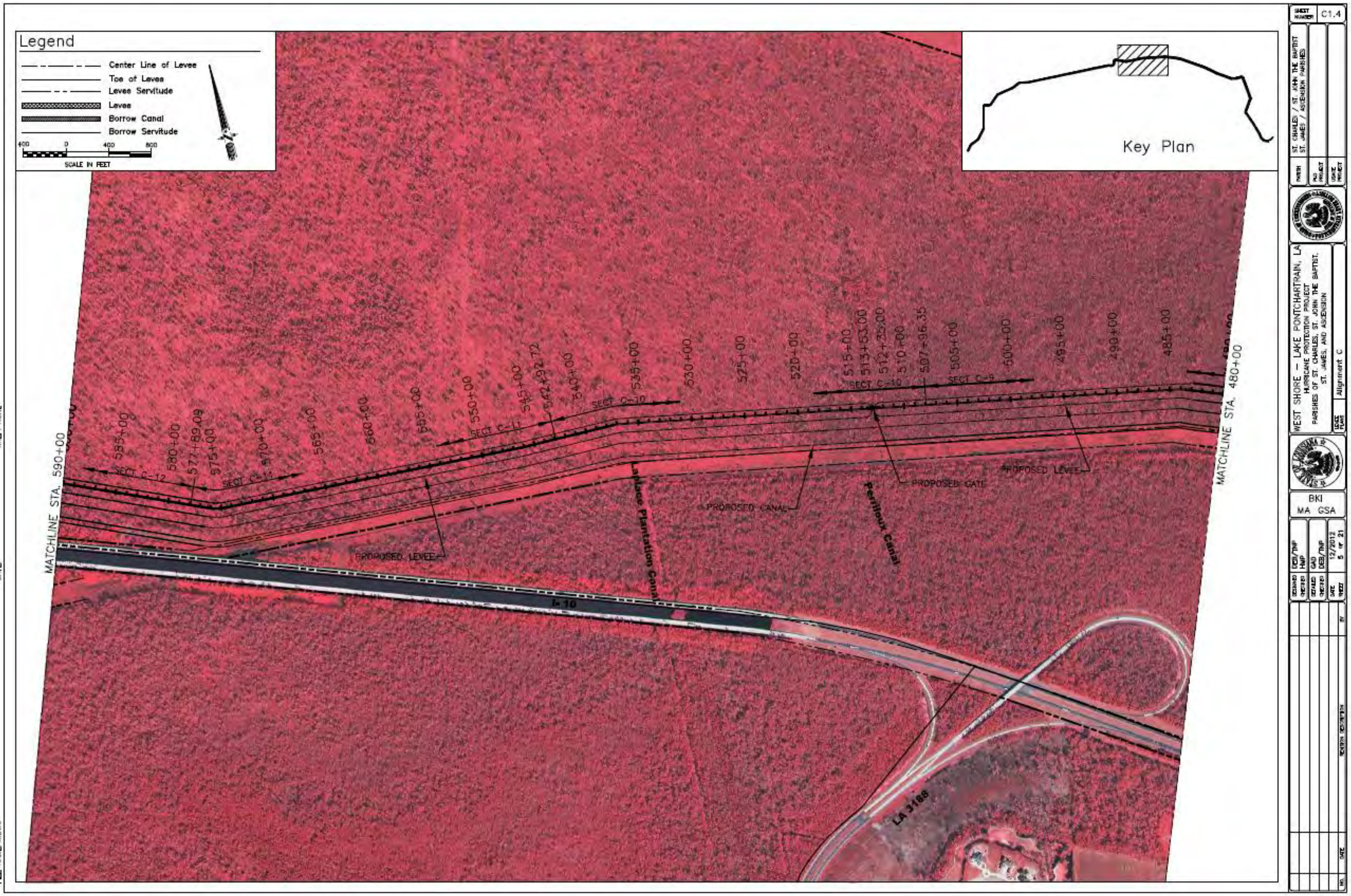
PROJECT MAPS


Legend
Center Line of Levee
Toe of Levee
Levee Servitude
Levee
Borrow Canal
Borrow Servitude
SCALE IN FEET
Key Plan
Lake Pontchartrain
LaPlace
Garyville
Reserve
Bonnet Carre Spillway
WEST SHORE – LAKE PONTCHARTRAIN, LA
HURRICANE PROTECTION PROJECT
PARISHES OF ST. CHARLES, ST. JOHN THE BAPTIST, ST. JAMES, AND ASCENSION
Alignment C
C1.0
BKI
MA GSA
12/2012

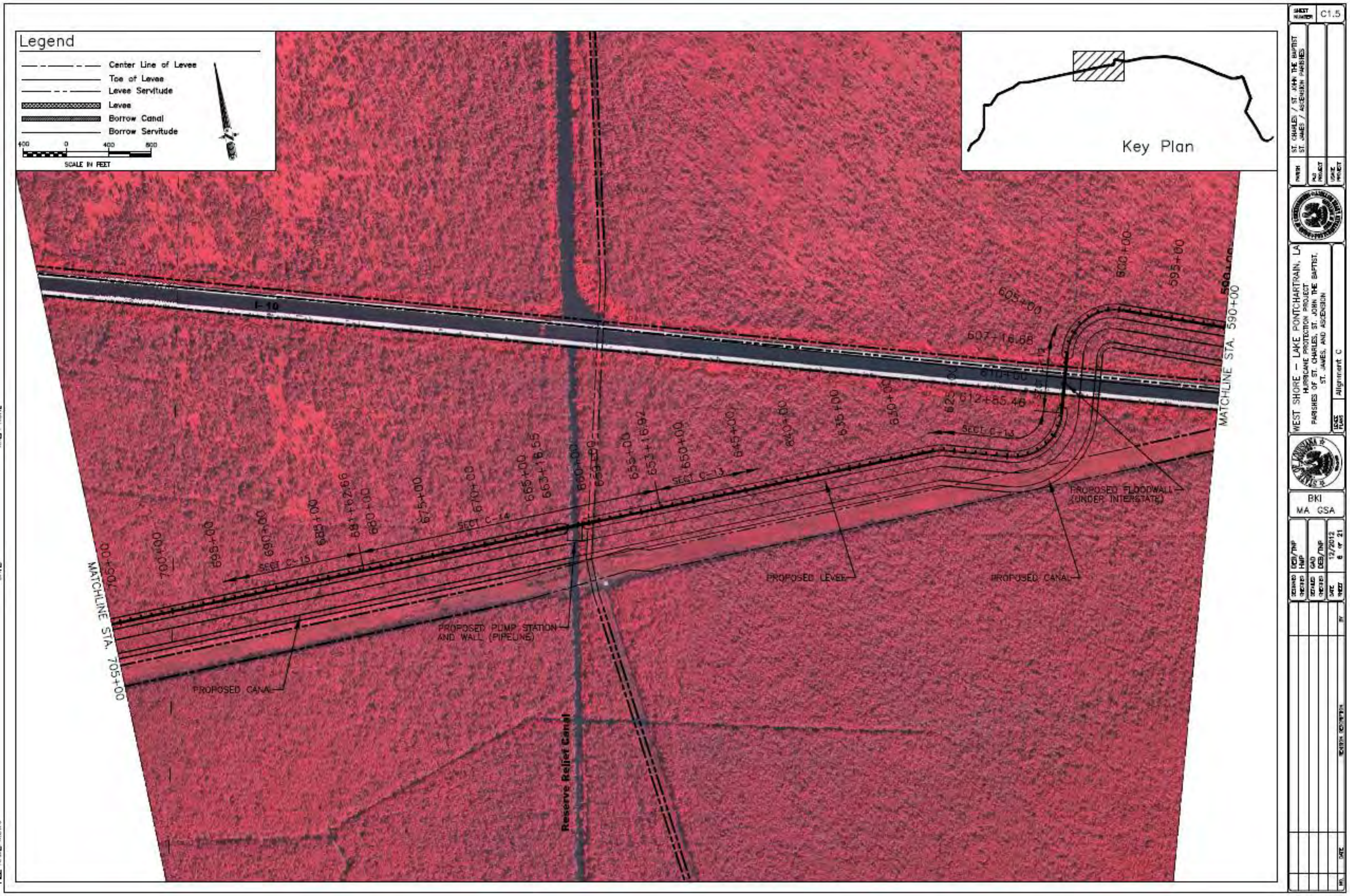
Legend
Center Line of Levee
Toe of Levee
Levee Servitude
Levee
Borrow Canal
Borrow Servitude
SCALE IN FEET
Key Plan
PEAVINE RD.
FRENIER RD.
PROPOSED FLOODGATE
PROPOSED PUMP STATION
PROPOSED CANAL
PROPOSED LEVEE
PROPOSED WALL (UNDER INTERSTATE)
PROPOSED WALL (PIPELINE)
MATCHLINE STA. 240+00
MATCHLINE STA. 370+00
US 51
I-10
I-55
WOODLAND CANAL
Underground Utility Pipelines R.O.W.
Overhead Power lines R.O.W.
SHEET NUMBER C1.2
ST. CHARLES / ST. JOHN THE BAPTIST
ST. JAMES / ASCENSION PARISHES
WEST SHORE – LAKE PONTCHARTRAIN, LA
HURRICANE PROTECTION PROJECT
PARISHES OF ST. CHARLES, ST. JOHN THE BAPTIST, ST. JAMES, AND ASCENSION
LEVEE PLANS
Alignment C
BKI
MA GSA
DEB/TNP
HMP
GAD
DEB/TNP
12/2012
3 of 21

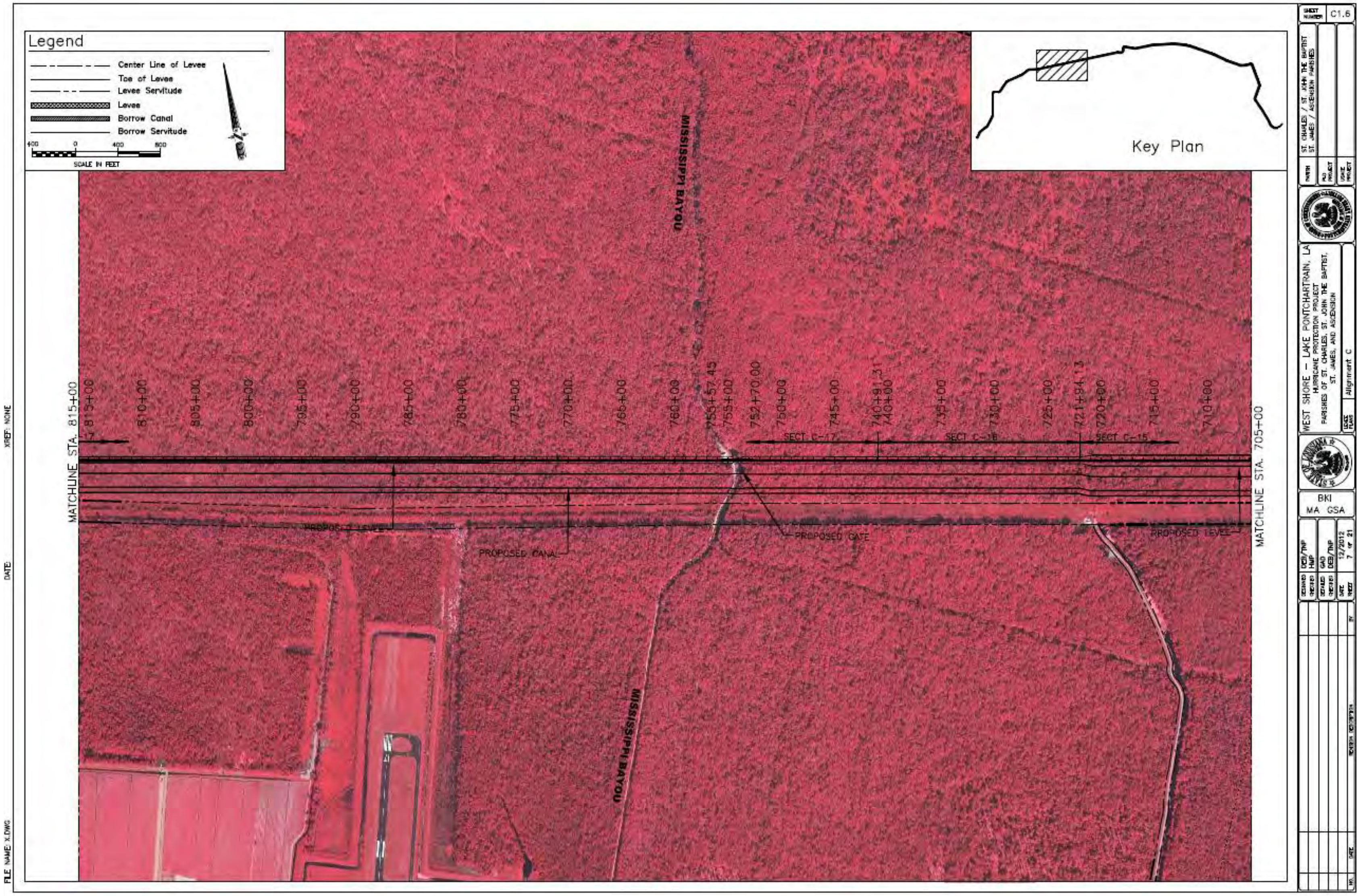


Legend
Center Line of Levee
Toe of Levee
Levee Servitude
Levee
Borrow Canal
Borrow Servitude
SCALE IN FEET
Key Plan
Overhead Power lines/Underground Utility Pipelines R.O.W.
Underground Utility Pipelines R.O.W.
PROPOSED LEVEE
PROPOSED PUMP STATION
PROPOSED CANAL
PROPOSED WALL (PIPELINE)
MATCHLINE STA. 480+00
MATCHLINE STA. 370+00
Ridgefield Canal
Tabo Canal
Vicknair Canal
I-10
C1.3
WEST SHORE – LAKE PONTCHARTRAIN, LA
HURRICANE PROTECTION PROJECT
PARISHES OF ST. CHARLES, ST. JOHN THE BAPTIST, ST. JAMES, AND ASCENSION
Alignment C
BKI
MA GSA
12/2012
4 of 21

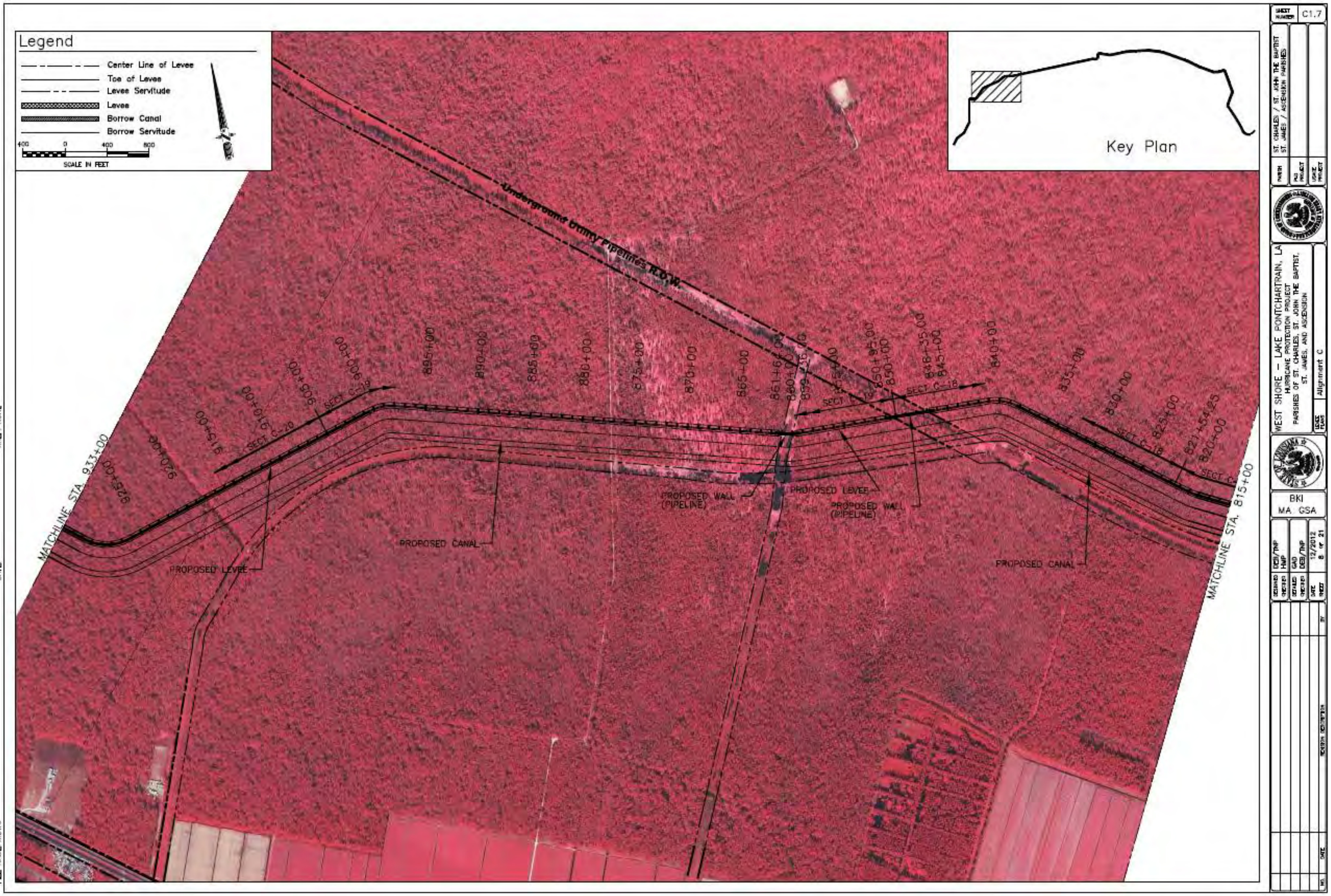


Legend
Center Line of Levee
Toe of Levee
Levee Servitude
Levee
Borrow Canal
Borrow Servitude
SCALE IN FEET
Key Plan
MATCHLINE STA. 590+00
MATCHLINE STA. 480+00
PROPOSED LEVEE
PROPOSED CANAL
PROPOSED GATE
Peruthous Canal
I-10
LA 3188
WEST SHORE – LAKE PONTCHARTRAIN, LA
HURRICANE PROTECTION PROJECT
PARISHES OF ST. CHARLES, ST. JOHN THE BAPTIST, ST. JAMES, AND ASCENSION
Alignment C
BKI
MA GSA
C1.4

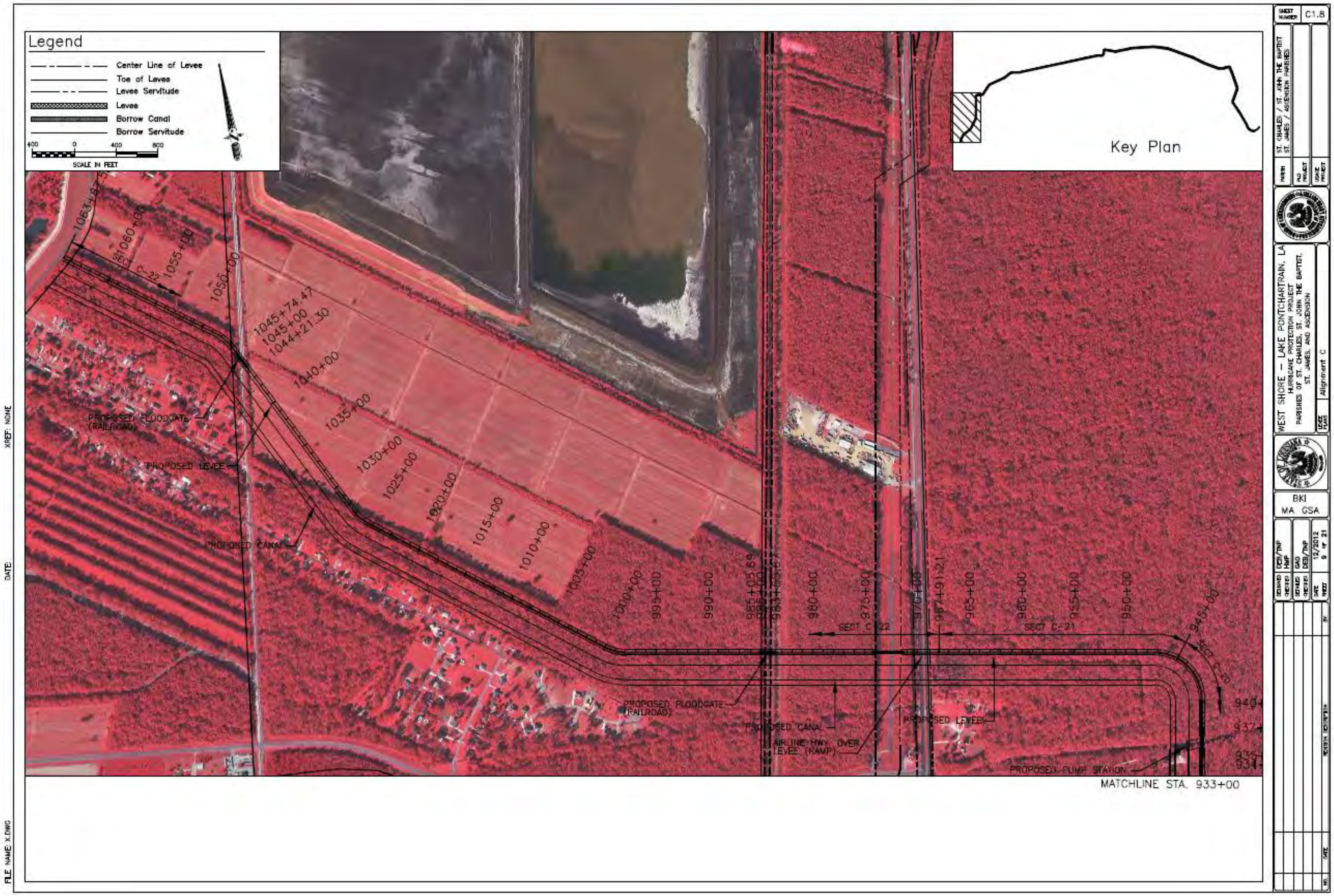

Legend
Center Line of Levee
Toe of Levee
Levee Servitude
Levee
Borrow Canal
Borrow Servitude
SCALE IN FEET
Key Plan
I-10
PROPOSED LEVEE
PROPOSED CANAL
PROPOSED FLOODWALL (UNDER INTERSTATE)
PROPOSED PUMP STATION AND WALL (PIPELINE)
Reserve Relief Canal
MATCHLINE STA. 590+00
MATCHLINE STA. 705+00
WEST SHORE – LAKE PONTCHARTRAIN, LA
Alignment C
C1.5



Legend
Center Line of Levee
Toe of Levee
Levee Servitude
Levee
Borrow Canal
Borrow Servitude
SCALE IN FEET
Key Plan
MISSISSIPPI BAYOU
MATCHLINE STA. 815+00
MATCHLINE STA. 705+00
PROPOSED LEVEE
PROPOSED CANAL
PROPOSED GATE
SECT. C-17
SECT. C-16
SECT. C-15
C1.6
WEST SHORE – LAKE PONTCHARTRAIN, LA
HURRICANE PROTECTION PROJECT
Alignment C
BKI
MA GSA



Legend
Center Line of Levee
Toe of Levee
Levee Servitude
Levee
Borrow Canal
Borrow Servitude
SCALE IN FEET
Key Plan
Underground Utility Pipelines R.O.W.
PROPOSED LEVEE
PROPOSED CANAL
PROPOSED WALL (PIPELINE)
MATCHLINE STA. 933+00
MATCHLINE STA. 815+00
WEST SHORE – LAKE PONTCHARTRAIN, LA
HURRICANE PROTECTION PROJECT
PARISHES OF ST. CHARLES, ST. JOHN THE BAPTIST, ST. JAMES, AND ASCENSION
Alignment C
C1.7
BKI
MA GSA
12/2012
8 of 21



Legend
Center Line of Levee
Toe of Levee
Levee Servitude
Levee
Borrow Canal
Borrow Servitude
SCALE IN FEET
Key Plan
PROPOSED FLOODGATE (RAILROAD)
PROPOSED LEVEE
PROPOSED CANAL
AIRLINE HWY. OVER LEVEE (RAMP)
PROPOSED PUMP STATION
MATCHLINE STA. 933+00
WEST SHORE – LAKE PONTCHARTRAIN, LA
HURRICANE PROTECTION PROJECT
PARISHES OF ST. CHARLES, ST. JOHN THE BAPTIST, ST. JAMES, AND ASCENSION
Alignment C
C1.8
BKI
MA GSA

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX C

ANNEX B

ASSESSMENT OF NON-FEDERAL SPONSOR'S

ACQUISITION CAPABILITY

ASSESSMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITY

COASTAL PROTECTION AND RESTORATION AUTHORITY (CPRA)

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? **YES, if property title is required for the purpose of this project.**

b. Does the sponsor have the power of eminent domain for this project? **NO. Although the Sponsor does not have eminent domain authority, if this should be needed for the project, the Sponsor may partner with a Levee District or Parish Government which has that authority (Act 225 RS38:301.1 and Act 320), if they agree.**

c. Does the sponsor have "quick-take" authority for this project? **NO. Although the Sponsor does not have quick take authority, if this should be needed for the project, the Sponsor may partner with a Levee District or Parish Government which has that authority (Act 225 RS38:301.1 and Act 320), if they agree.**

d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? **NO**

e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? **Unknown**

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended? **NO**

b. If the answer to II.a. is "yes," has a reasonable plan been developed to provide such training? **N/A**

c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? **YES**

d. Is the sponsor's projected in-house staffing level sufficient considering its other workload, if any, and the project schedule? **Not at this time. However, CPRA has numerous contracts in place which provide ample resources.**

CPRA is presently under development. It is expected that the staff will continue to grow in the upcoming months/years, provided sufficient budget and proper legal authorities.

e. Can the sponsor obtain contractor support, if required in a timely fashion? **YES, contracts are in place now.**

f. Will the sponsor likely request USACE assistance in acquiring real estate? **It is not likely that the Sponsor will request assistance.**

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site? **YES**

b. Has the sponsor approved the project/real estate schedule/milestones? **At the feasibility level, there are too many unknowns to develop a definite project schedule. Once project designs are finalized, the Sponsor will be requested to provide an acquisition schedule.**

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? **YES**

b. With regard to this project, the sponsor is anticipated to be: highly capable/fully capable/moderately capable/marginally capable/insufficiently capable. **Highly capable.**

V. Coordination:

a. Has this assessment been coordinated with the sponsor? **YES**

b. Does the sponsor concur with this assessment? **YES**

Prepared by:

Karen E. Vance

Karen E. Vance
Realty Specialist
Appraisal & Planning Branch
Real Estate Region South Division
USACE

1/13/13
Date

Approved by:

CWallace

Cynthia Wallace
Chief, Real Estate/Land Rights Division
Coastal Protection & Restoration Authority

1/9/13
Date

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX C

ANNEX C

BASELINE COST ESTIMATES/

CHARTS OF ACCOUNTS

WEST SHORE LAKE PONTCHARTRAIN PROJECT
REAL ESTATE COST ESTIMATE
ALTERNATIVE C

BASED ON COST ESTIMATES PROVIDED IN APRIL, 2013							
					AMOUNT	CONTINGENCY	PROJECT
							COST
						ROUNDED	84,700,000
	TOTAL PROJECT COSTS				67,759,800	16,939,950	84,699,750
01	**LANDS AND DAMAGES**		CONTINGENCY	PROJECT	67,759,800	16,939,950	84,699,750
				COST			
01B	**ACQUISITIONS**						
01B10	BY GOVERNMENT	0	0	0			
01B20	BY NON-FEDERAL SPONSOR (NFS)	35,775,600	8,943,900	44,719,500			
01B30	BY GOVT ON BEHALF OF LS	0	0	0			
01B40	REVIEW OF LS	12,042,200	3,010,550	15,052,750			
01C	**CONDEMNATIONS**						
01C10	BY GOVERNMENT	0	0	0			
01C20	BY LS	360,000	90,000	450,000			
01C30	BY GOVT ON BEHALF OF LS	0	0	0			
01C40	REVIEW OF LS	0	0	0			
01F	**PL 91-646 ASSISTANCE**						
01F10	BY GOVERNMENT	0	0	0			
01F20	BY LS	0	0	0			
01F30	BY GOVT ON BEHALF OF LS	0	0	0			
01F40	REVIEW OF LS	0	0	0			
01R	**REAL ESTATE PAYMENTS**						
01R1	**LAND PAYMENTS**						
01R1A	BY GOVERNMENT	0	0	0			
01R1B	BY LS	7,983,000	1,995,750	9,978,750			
01R1C	BY GOVT ON BEHALF OF LS	0	0	0			
01R1D	REVIEW OF LS	0	0	0			
01R2	**PL 91-646 ASSISTANCE PAYMENTS**						
01R2A	BY GOVERNMENT	0	0	0			
01R2B	BY LS	11,599,000	2,899,750	14,498,750			
01R2C	BY GOVT ON BEHALF OF LS	0	0	0			
01R2D	REVIEW OF LS	0	0	0			
	ASSUMES 120 LANDOWNERS						

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX C

ANNEX D

NON-MATERIAL DEVIATION FROM

STANDARD ESTATE

TEMPORARY ACCESS EASEMENT

TEMPORARY ACCESS EASEMENT

A non-exclusive and assignable temporary easement for a period not to exceed _____ years beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as an access route and/or right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. _____, _____ and _____); together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way, reserving, however, to the owners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired, including the right to cross over the right-of-way as access to their adjoining land; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

In accordance with paragraph 12-9 c. of ER 405-1-12, the District Chief of Real Estate may approve a non-standard estate if it serves the intended project purpose, substantially conforms with and does not materially deviate from a corresponding standard estate, and does not increase the costs or potential liability of the Government. The foregoing estate complies with those requirements as it achieves the project purpose in as narrow a manner as practical, and is a minor modification of the standard Road Easement, adding language for a temporary term and replacing the word "road" with the words "access route and/or right of way.

Reviewed by:

Marco Rosamano

Marco Rosamano
Assistant District Counsel
New Orleans District

Approved by:

Linda Labure
Chief, Real Estate Division
New Orleans District

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX C

ANNEX E

PERPETUAL UNDERGROUND PILING EASEMENT

PERPETUAL UNDERGROUND PILING EASEMENT

A perpetual and assignable easement and right-of-way in, on, over and across (the land described in Schedule A) (Tract Nos. ____, ____, and ___), to locate, construct, operate, maintain, alter, repair, replace and patrol the underground appurtenances for a flood control wall, including but not limited to steel or concrete pilings, reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

Estate was approved by Monroe L. Lesser on July 10, 2006 to accommodate construction of T-wall type floodwalls in south Louisiana as authorized and funded under: (1) P.L. 84-99 (Task Force Guardian Repair and Rehabilitation); (2) Department of Defense, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza Act, 2006, Public Law 109-148, (3rd Supplemental); (3) Emergency Supplemental Appropriations Act for Defense, the Global War on Terror and Hurricane Recovery 2006, Public Law 109-234 (4th Supplemental); and (4) any future floodwall projects.

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX C

ANNEX F

FACILITY/UTILITY RELOCATIONS

COMPANY	PRODUCT	SIZE
MARATHON ASHLAND PIPELINE LLC	CRUDE OIL	30”
SHELL PIPELINE COMPANY	REFINED PRODUCTS LINE	24”
UNKNOWN	GAS	24”
ST JOHN THE BAPTIST PARISH POTABLE WATER		24”
SHELL PIPELINE COMPANY LP	AREA WIDE MAINTENANCE	24”
MARATHON ASHLAND PIPELINE LLC	PETROLEUM PRODUCT	20”
WILPRISE (ENTERPRISE) PIPELINE COMPANY	PIPELINE	12.75”
SOUTHERN STATES PIPELINE COMPANY	GAS	12.75”
WILPRISE (ENTERPRISE) PIPELINE COMPANY	NATURAL GAS LIQUID	12”
SHELL PIPELINE COMPANY LP	PIPELINE AREA WIDE MAINTENANCE	12”
WILPRISE (ENTERPRISE) PIPELINE COMPANY	NATURAL GAS LIQUID	12”
WILPRISE (ENTERPRISE) PIPELINE COMPANY		12”
AIR PRODUCTS	HYDROGEN DUPONT MAINLINE	12”
GULF LIQUIDS NEW RIVER		12”
GULF INTERSTATE/BIG THREE INDUSTRIES	NITROGEN	12”
GULF INTERSTATE/BIG THREE INDUSTRIES	OXYGEN	12”
WILPRISE (ENTERPRISE) PIPELINE COMPANY		12”
GULF LIQUIDS NEW RIVER		12”
TEXACO PIPELINE LLC	EXISTING PIPELINE MAINTANENCE	8”
BRIDGELINE GAS DISTRIBUTION LLC	SURVEY LINE	8”
ENTERPRISE PIPELINE COMPANY	PROPANE	8”
SORRENTO (ENTERPRISE) PIPELINE COMPANY		8”
ENTERPRISE – WILPRISE	NGL PROPANE	6.629”
WILPRISE PIPELINE COMPANY	PIPELINE MAINTENANCE – CLEAR ROW	6”
WILPRISE PIPELINE COMPANY	PIPELINE MAINTENANCE – CLEAR ROW	6”
BRIDGELINE GAS DISTRIBUTION LLC	BUTANE	6”
NICOR EXPLORATION GAS	GAS	6”
CHEVRON TEXACO	AREA WIDE FLOWLINE MAINTENANCE & REPAIR (SS01)	6”
BRIDGELINE GAS DISTRIBUTION LLC	PROPANE	6”
SHELL PIPELINE COMPANY LP	FLOWLINE INSPECT/REPAIR	6”
LIG	GAS	4”
SHELL OIL COMPANY	EPSILON ETHYLENE CONNECTION	4”
SHELL PIPELINE COMPANY LP	EXISTING PIPELINE MAINTENANCE	4”
I.P. PETROLEUM COMPANY	PIPELINE	4”
ENTERPRISE PIPELINE COMPANY	LIQUIFIED PETROLEUM GASES (PROPANE)	

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX C

ANNEX G

REAL ESTATE POLICY GUIDANCE LETTER NO. 31

REAL ESTATE SUPPORT TO CIVIL WORKS

PLANNING PARADIGM (3X3X3)

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET NW
WASHINGTON, D.C. 20314-1000

REPLY TO
ATTENTION OF:

CEMP-CR

JAN 1 0 2013

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Real Estate Policy Guidance Letter No. 31-Real Estate Support to Civil Works Planning Paradigm (3x3x3)

1. References.

a. Memorandum, CECW-CP, 8 February 2012, Subject: U.S. Army Corps of Engineers Civil Works Feasibility Study Program Execution and Delivery

b. ER 5-1-11, USACE Business Process, 1 November 2006

c. EC 405-1-04, Appraisal, 30 Dec 2003

d. ER 1105-2-100, Planning Guidance Notebook, 22 Apr 2000

e. ER 405-1-12, Chapter 12, Real Estate Roles and Responsibilities for Civil Works, Cost Shared and Full Federal Projects, Change 31, 1 May 1998

2. Purpose. In accordance with reference a, this memorandum provides interim policy and guidance for real estate efforts associated with feasibility studies under the new Planning Paradigm, "SMART Planning," and the 3x3x3 rule. In accordance with the 3x3x3 rule, all feasibility studies should be completed within three years, at a cost of no more than $3 million, utilize three levels of vertical team coordination, and be of a "reasonable" report size.

3. Background. Real Estate has been fully engaged in the implementation of the 3x3x3 by actively participating in each webinar, the planning modernization workshop, and serving as part of the HQ Transition Team. In accordance with references b-e, Real Estate involvement is essential to the development and implementation of any pre-authorization project. Paragraph 12-16 of reference e. outlines the significant topics that must be covered in a real estate plan (REP). The level of detail necessary to apply the requirements of real estate policy and guidance will vary depending on the scope and complexity of each project.

As outlined in Chapter 12, the minimum interests in real property necessary to support various types of projects must be identified. As projects are scoped at the beginning of the feasibility phase (via a Charette or other forum), it is essential that Real Estate become familiar with the project authority and purposes to make a determination of the minimum interests and estate(s), both standard and non-standard, necessary as projects are scoped and alternatives evaluated. If a non-standard estate will be needed, this should be discussed with MSC and HQ Real Estate as early as possible to ensure that the justification is sound and will serve the project purpose.

4. Policy. Typically, the attorney's preliminary opinion of compensability and gross appraisals are two areas that require more detail than may be readily available during the start of the feasibility phase, and are critical to determination of accurate estimates for real estate and total project costs. Due to the focus on 3 years or less for study duration, it will be essential for Real Estate to be adaptable and scale its requirements, decision making, and risk management in proportion to the significance of total project costs.

a. Gross Appraisals:

Specific to gross appraisals, EC 405-1-04 provides that cost estimates are utilized for preliminary planning of projects and in other cases, brief gross appraisals are acceptable. For purposes of the feasibility phase, the detail will vary as outlined below.

(1) For projects in which the value of real estate (lands, improvements, and severance damages) are not expected to exceed ten percent of total project costs (total cost to implement project), a cost estimate (or rough order of magnitude) will be acceptable for purposes of the feasibility phase.
(2) For projects in which the value of real estate (lands, improvements, and severance damages) do not exceed 30 percent of total project costs (total cost to implement project), a brief gross appraisal will be acceptable for purposes of the feasibility phase. A brief gross appraisal will follow format issued by Chief Appraiser.
(3) For projects in which the value of real estate (lands, improvements, and severance damages) exceed 30 percent of total project costs (total cost to implement project), a full gross appraisal will be prepared in accordance with the appraisal regulation and guidance provided by EC 405-1-04 and the Chief Appraiser.

b. Attorney's Opinion of Compensability:

As described in paragraph 12-17 of Chapter 12, utility/facility relocations may require preliminary attorney's opinions of compensability. While the practice of obtaining preliminary attorney's opinions of compensability provides a high degree of certainty with regard to project costs during the feasibility phase, such opinions can be time consuming and may provide more certainty than may be optimal for feasibility purposes when potential utility/facility relocation costs do not constitute a large percentage of total project costs. In support of the goals set out in the new planning paradigm described in reference a., Districts shall adhere to the following guidance:

(1) Where the estimated total cost to modify all project utility facility relocations, including the value of any additional lands that may be required to perform the relocations does not exceed 30 percent of estimated total project costs, the District Office of Real Estate shall, in lieu of an attorney s opinion of compensability prepare a real estate assessment. Such a real estate assessment, will address the following questions:

(a) Is the identified utility facility generally of the type eligible for compensation under the substitute facilities doctrine (e.g., school, highway, bridge, water and sewer systems, parks, etc.)
(b) Does the District have some valid data or evidence that demonstrates that it has identified an owner with a compensable interest in the property

If the answer to both questions is yes, then the District Office of Real Estate shall reflect the cost of providing a substitute facility in the Real Estate Plan (REP) and all other feasibility study cost estimates. If the answer to either or both questions is no, the District shall not reflect the cost of a substitute facility in the REP or other feasibility study cost estimates. However, the REP narrative should still include a discussion on the facility with results of analysis and project impact. For cost shared projects, the non-federal sponsor must be advised that the inclusion of substitute facilities costs in the REP or other use feasibility study estimates is for planning and budgeting purposes only and does not constitute a preliminary or final determination of compensability by the agency regardless of whether the cost of substitute facilities are reflected in the feasibility study documents. Using a real estate assessment does not eliminate the need to obtain a final attorney s opinion of compensability prior to execution of the PPA.

(2) Where the estimated total cost to modify all project facility relocations, including the value of any additional lands that may be required to perform the relocations, has public or political significance or the costs exceed 30 percent of estimated total project costs, a preliminary opinion of compensability shall be prepared for each owner s facilities. The level of documentation for each relocation item should be based on the significance of the relocation item to project formulation and estimated project costs.

Real Estate products, such as the REP, must be adaptable and scaled based on the project scope. Additionally, Real Estate must utilize the risk register to highlight areas where cost, schedule or uncertainty is greater in order to manage risk. Going forward, the Real Estate Division will continue to work closely with the Planning and Policy Division, Engineering and Construction Division, the Programs Integration Division and the National Law Firm on the Planning SmartGuide. This SmartGuide will provide more on procedures, tips, techniques and tools for

CEMP-CR
SUBJECT: Real Estate Policy Guidance Letter No. 31-Real Estate Support to Civil Works Planning Paradigm (3x3x3)

specific types of planning projects to aid in implementation of the new Planning Paradigm. All bulletins and updates on the SmartGuide can be found at: http://planning.usace.army.mil/toolbox/.

5. Duration. The policies stated herein will remain in effect until amended or rescinded by Policy Memorandums, Policy Guidance Letters, Engineers Circulars or Engineer Regulations.

FOR THE COMMANDER:

SCOTT L. WHITEFORD
DIRECTOR OF REAL ESTATE

DISTRIBUTION:
COMMANDER,
GREAT LAKES AND OHIO RIVER DIVISION (CELRD-PDS-R)
MISSISSIPPI VALLEY DIVISION (CEMVD-TD-R)
NORTH ATLANTIC DIVISION (CENAD-PD-E)
NORTHWESTERN DIVISION (CENWD-PDS)
PACIFIC OCEAN DIVISION (CEPOD-RE)
SOUTH ATLANTIC DIVISION (CESAD-PDS-R)
SOUTH PACIFIC DIVISION (CESPD-ET-R)
SOUTHWESTERN DIVISION (CESWD-ET-R)

CF:
COMMANDER,
DETROIT DISTRICT (CELRE-RE)
HUNTINGTON DISTRICT (CELRH-RE)
LOUISVILLE DISTRICT (CELRL-RE)
NASHVILLE DISTRICT (CELRN-RE)
PITTSBURGH DISTRICT (CELRP-RE)
MEMPHIS DISTRICT (CEMVM-RE)
NEW ORLEANS DISTRICT (CEMVN-RE)
ROCK ISLAND DISTRICT (CEMVR-RE)
ST. LOUIS DISTRICT (CEMVS-RE)
ST. PAUL DISTRICT (CEMVP-RE)
VICKSBURG DISTRICT (CEMVK-RE)
BALTIMORE DISTRICT (CENAB-RE)
NEW ENGLAND DISTRICT (CENAE-RE)
NEW YORK DISTRICT (CENAN-RE)
NORFOLK DISTRICT (CENAO-RE)

CEMP-CR
SUBJECT: Real Estate Policy Guidance Letter No. 31-Real Estate Support to Civil Works Planning Paradigm (3x3x3)

KANSAS CITY DISTRICT (CENWK-RE)
OMAHA DISTRICT (CENWO-RE)
PORTLAND DISTRICT (CENWP-RE)
SEATTLE DISTRICT (CENWS-RE)
WALLA WALLA DISTRICT (CENWW-RE)
ALASKA DISTRICT (CEPOA-RE)
HONOLULU DISTRICT (CEPOH-PP-RE)
JACKSONVILLE DISTRICT (CESAJ-RE)
MOBILE DISTRICT (CESAM-RE)
SAVANNAH DISTRICT (CESAS-RE)
ALBUQUERQUE DISTRICT (CESPA-RE)
LOS ANGELES DISTRICT (CESPL-RE)
SACRAMENTO DISTRICT (CESPK-RE)
FORT WORTH DISTRICT (CESWF-RE)
GALVESTON DISTRICT (CESWG-RE)
LITTLE ROCK DISTRICT (CESWL-RE)
TULSA DISTRICT (CESWT-RE)
CECC-R

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

ECONOMIC
APPENDIX D

D-1: Background Information
D-2: Economic and Engineering Inputs to the HEC-FDA Model
D-3: National Economic Development (NED) Flood Damage and Benefit Calculations

West Shore Lake Pontchartrain LA Hurricane and Surge Risk Reduction Feasibility Study
ECONOMIC APPENDIX OUTLINE

Contents

LIST OF TABLES

PART 1: BACKGROUND INFORMATION

INTRODUCTION

General. This appendix presents an economic evaluation of the three storm surge risk reduction alternatives being considered for the West Shore Lake Pontchartrain LA Hurricane and Surge Risk Reduction Feasibility Study (West Shore Lake Pontchartrain), evaluation area, which includes portions of three parishes in the state of Louisiana. It was prepared in accordance with Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, and ER 1105-2-101, Planning Guidance, Risk Analysis for Flood Damage Reduction Studies. The National Economic Development Procedures Manual for Flood Risk Management and Coastal Storm Risk Management, prepared by the Water Resources Support Center, Institute for Water Resources, was also used as a reference, along with the User's Manual for the Hydrologic Engineering Center Flood Damage Analysis Model (HEC-FDA).

The economic appendix consists of a description of the methodology used to determine National Economic Development (NED) damages under existing and future conditions and projects costs. The evaluation reports damages and costs at October 2012 price level. The proposed alternatives were evaluated by comparing total project costs. The evaluation was conducted on the expectation that each alternative would perform equally thus provide the same level of risk reduction. Damages were converted to equivalent annual values by use of the current FY 2013 Federal discount rate of 3.75 percent and a period of analysis of 50 years. The year 2020 was identified as the base year for each of the alternatives as the basis for plan comparison. Three alternatives were screened to arrive at the selected alignment.

NED Benefit Categories Considered. The NED procedure manuals for coastal and urban areas recognize four primary categories of benefits for flood risk management measures: inundation reduction, intensification, location, and employment benefits. The majority of the benefits attributable to a project alternative generally result from the reduction of actual or potential damages caused by inundation. Inundation reduction, which is the only category of NED benefits addressed in this evaluation, includes the reduction of physical damages to structures, contents, and vehicles.

Physical Flood Damage Reduction. Physical flood damage reduction benefits include the decrease in potential damages to residential and commercial structures, their contents, and the privately owned vehicles associated with these structures. Damages included in the appendix considered both existing and future conditions. Projections of the future development expected to be in place in the study area during the period of analysis were included as part of the future condition analysis.

Office of Management and Budget survey forms were used to collect information on the value and placement of contents in the industrial facilities located in the study area. The information from these surveys was used to develop the physical flood damage and benefits for these industrial properties.

Emergency Cost Reduction Benefits. Emergency costs are those costs incurred by the community during and immediately following a major storm. They include the costs of emergency measures, such as evacuation and reoccupation activities conducted by local governments and homeowners, repair of streets, highways, and railroad tracks, and the subsequent cleanup and restoration of private, commercial, and public properties. In this evaluation, only the emergency cost reduction benefits associated with debris removal and cleanup and the reduction of damages to major and secondary highways and streets were considered. Emergency costs will be evaluated for the Tentatively Selected Plan (TSP) in the draft feasibility report.

Regional Economic Development. The RED account will be addressed in a separate appendix in the final feasibility report to evaluate the project alternatives. If the economic activity lost in the flooded region can be transferred to another area or region in the national economy, then these losses are not included in the NED account. However, the impacts on the employment, income, and output of the regional economy are considered part of the RED account. The input-output macroeconomic model RECONS will be used to address the impacts of the construction spending only associated with the TSP, since only this alternative provides detailed cost information necessary to prepare a complete and accurate analysis.

DESCRIPTION OF THE STUDY AREA

Geographic Location. The study area includes the portions of St. James and St. John the Baptist Parishes located on the east bank of the Mississippi River and the portion of St. Charles Parish on the east bank of the Mississippi River west of the Bonnet Carre' Spillway. The West Shore Lake Pontchartrain evaluation area was divided into 81 unique hydrologic reaches to enable an economic analysis of the project alternatives through the use of the HEC-FDA certified model.

Land Use. The total number of acres of developed, agricultural, and undeveloped land in the study area is shown in **Table 1**. As shown in the table, approximately 5 percent of the total acres in the study area are currently developed. Since there are approximately 24,000 acres of agricultural land and 124,000 acres of undeveloped land there is sufficient land available to accommodate the projected residential and non-residential development through the year 2080 without impacting the wetlands in the area. This projected future development is expected to be located on parcels that tend to be relatively higher ground and are the least exposed to flood risk.

Table 1: Land Use in the Study Area

Land Use in the Study Area
West Shore Lake Pontchartrain, LA Feasibility Study
(2009)

Land Class Name	Acres	Percentage of Total
Developed land	10,947	4.7
Agricultural Land	23,779	10.3
Undeveloped Land	124,181	53.9
Open Water	71,576	31.1
Total	**230,483**	**100.0**

Source: National Agricultural Statistical Service
Note: Sugarcane accounts for approximately half of the agricultural land and pasture/hay the remainder.

SOCIOECONOMIC SETTING

Population and Number of Households. **Table 2** displays the population in each of the parishes for the years 1980, 1990, 2000, and 2010 as well as projections for the year 2020 and the year 2080, the two years that engineering inputs were modeled and used to calculate damages. Population projections are based on the Moody's County Forecast Database, which has population projections to the year 2038. Moody's projections were extended by New Orleans District from the year 2030 to the year 2080 based on the growth rate forecasted by Moody's for the years 2018 through 2038. As shown in **Table 2**, St. Charles, St. James and St. John Parishes experienced a steady increase in population between 1980 and 2010.

Table 2: Historical and Projected Parish Population
West Shore Lake Pontchartrain, LA Feasibility Study
(1,000s)

Parish	1980	1990	2000	2010	2020	2080
St. Charles	37.5	42.5	48.2	52.8	56.2	65.5
St. James	21.6	20.8	21.4	22.1	22.3	26.5
St. John the Baptist	32.3	40.1	43.1	45.9	51.7	60.2
Total	91.4	103.4	112.7	120.8	130.2	152.1

Source: U.S. Census data, and Moody's County Forecast Database

Table 3 displays the estimated population of the three parishes located within the inventoried portion of the study area for the year 2012 and the projected population for the years 2020 and 2070. The 2012 estimates are based on an inventory of residential and non-residential properties assembled in 2012 by field survey teams. The number of inventoried residential structures was then multiplied by 2.9, the average number of persons per household in the study area in 2012. The annual compounded growth rate in population between 2012 and 2020 is expected to be 0.32 percent and 0.77 percent between 2020 and 2070.

Table 3: Existing Condition and Projected Population within Inventoried Study Area
West Shore Lake Pontchartrain, LA Feasibility Study
(1,000s)

Parish	2012	2020	2070
Total in Study Area	62.90	64.7	95.9

Source: U.S. Census data, and Moody's County Forecast Database
Note: Population estimates uses 2.9 residents per housing unit and 20 housing units within a multi family structure.

Table 4 shows the total number of households in each parish for the years 1980, 1990, 2000, and 2010 and projections for the years 2020 and 2080. The projected number of households was based on the Moody's County Forecast Database and extended from the year 2038 to the year 2080 based on the growth rate forecasted by Moody's for the years 2018 through 2038.

Table 4: Number of Households by Parish
West Shore Lake Pontchartrain, LA Feasibility Study
(1,000s)

Parish	1980	1990	2000	2010	2020	2080
St. Charles	11.6	14.4	16.5	17.2	18.3	22.0
St. James	6.1	6.4	7.0	6.9	7.2	8.7
St. John the Baptist	9.4	12.7	14.3	15.1	16.3	19.6
Total	**27.1**	**33.5**	**37.8**	**39.2**	**41.8**	**50.2**

Source: U.S. Census data, and Moody's County Forecast Database

The three parishes experienced a steady increase in the total number of households between 1980 and 2010, which paralleled the growth in population. This increase is commensurate with the population growth experienced by the entire Gulf Coast region during the same period. Similar to the projected population growth in the three-parish area, the number of households is expected to continue increasing through the year 2080.

Income. **Table 5** shows the per capita personal income levels for each parish for the years 1990, 2000, 2005, 2010 and 2012, the year with the latest available data. As shown in the table, both parishes experienced a steady increase in per capita income between 1990 and 2012.

Table 5: Per Capita Income ($s)
West Shore Lake Pontchartrain, LA Feasibility Study

Parish	1990	2000	2005	2010	2012
St. Charles	$ 17,296.80	$ 24,227.67	$ 26,825.53	$ 32,598.93	$ 34,991.97
St. John the Baptist	$ 14,231.16	$ 18,326.72	$ 22,950.56	$ 29,663.46	$ 31,492.16
St. James	$ 14,440.30	$ 19,719.82	$ 24,714.85	$ 29,351.24	$ 31,348.64

Source: U.S. Census data, and Moody's County Forecast Database

Employment. **Table 6** shows the total nonfarm employment by parish for the years 1970, 1980, 1990, 2000, 2010, and projections for the years 2020 and 2080. The employment projections were based on the Moody's County Forecast Database and extended from the year 2038 to the year 2080 based on the growth rate forecasted by Moody's for the years 2018 through 2038.

In all portions of the study area, growth is highly dependent upon the major employment sectors. The increase in employment in the three parishes is likely the result of the influx of population and businesses that occurred to the area after Hurricane Katrina after 2005. The leading employment sectors include educational services, health care and social assistance, manufacturing, and retail trade. Approximately 1,900 non-residential structures are located in the study area including petroleum service companies, river services companies, Zapp's Potato Chips Factory in Gramercy, and the Marathon refinery in Garyville. Slightly over 10 percent of the total acres in the study area, or 23,800 acres, is devoted to agriculture, and about half of these acres are used for growing sugar cane.

Table 6: Total non-Farm Employment

West Shore Lake Pontchartrain, LA Feasibility Study

(1,000s)

Parish	1970	1980	1990	2000	2010	2020	2080
St. Charles	9.0	18.1	18.5	20.1	24.3	26.3	36.2
St. John the Baptist	5.4	9.8	9.4	7.6	8.1	8.9	11.5
St. James	4.2	9.4	11.0	13.4	15.0	16.3	22.4
Total	18.5	37.2	39.0	41.1	47.4	51.5	70.1

Source: U.S. Census data, and Moody's County Forecast Database

Compliance with Policy Guidance Letter (PGL) 25 and Executive Order 11988. Given continued growth in employment, it is expected that development will continue to occur in the study area with or without the storm surge risk reduction system, and will not conflict with PGL 25 and EO 11988, which state that the primary objective of a hurricane storm damage and risk reduction project is to protect existing development, rather than to make undeveloped land available for more valuable uses. However, the overall growth rate is anticipated to be the same with or without the project in place. Thus, the project will not induce development, but would rather reduce the risk of the population being displaced after a major storm event.

RECENT FLOOD HISTORY

Tropical Flood Events. While the three parishes have periodically experienced localized flooding from excessive rainfall events, the primary cause of the flood events that have taken place in the three-parish study area has been the tidal surges from hurricanes and tropical storms. During the past 25 years, coastal Louisiana was impacted by eight major tropical events: Hurricane Juan (1985), Hurricane Andrew (1992), Tropical Storm Isidore and Hurricane Lili (2002), Hurricanes Katrina and Rita (2005), and Hurricanes Gustav and Ike (2008). While none of these storms tracked directly through the study area, the tidal surges associated with these storm events inundated structures and resulted in billions of dollars in damages throughout coastal Louisiana.

Table 7 provides a summary of the total Federal Emergency Management Agency (FEMA) flood claims paid to all Louisiana policyholders as a result of these tropical events. It should be noted these claims include losses due to rainfall along with storm surge events. The table includes the number of paid losses, the total amount paid, and the average amount paid on each loss. The total and average paid losses have been converted to reflect 2012 price levels. The table excludes losses that were not covered by flood insurance.

Table 7: FEMA Flood Claims in Louisiana
West Shore Lake Pontchartrain, LA Feasibility Study

Event	Year	Number of Paid Claims	Total Amount Paid (1,000s)	Average Amount Paid (1,000s)
Tropical Storm Juan	Oct-85	6,187	$ 194,019	$ 31.4
Hurricane Andrew	Aug-92	5,589	$ 276,748	$ 49.5
Tropical Storm Isadore	Sep-02	8,441	$ 144,990	$ 17.2
Hurricane Lili	Oct-02	2,563	$ 47,062	$ 18.4
Hurricane Katrina	Aug-05	167,099	$ 18,964,492	$ 113.5
Hurricane Rita	Sep-05	9,507	$ 550,946	$ 58.0
Hurricane Gustav	Sep-08	4,524	$ 117,786	$ 26.0
Hurricane Ike	Sep-08	46,137	$ 2,772,654	$ 60.1
Hurricane Isaac	Aug-12	3,565	$ 229,820	$ 64.5

Source: Federal Emergency Management Agency (FEMA)
Note: Total amount paid and average amount paid have been updated to the October 2012 price level using the CPI for all urban consumers
Hurricane Isaac claims only include claims in St. Charles, St. James and St. John Parishes

The following is a summary of each of the eight major tropical events and their effects on the two-parish area and coastal Louisiana.

Hurricane Juan. Hurricane Juan caused extensive flooding throughout southern Louisiana due to its prolonged 5-day movement back and forth along the Louisiana coast. Rainfall totals in the area ranged from 5 inches to almost 17 inches. The storm was responsible for storm surges of 5 to 8 feet and tides of 3 to 6 feet above normal. According to FEMA officials, the estimated value of the residential and commercial damage and public assistance throughout coastal Louisiana totaled $112.5 million.

Hurricane Andrew. On August 26, 1992, Hurricane Andrew made landfall in St. Mary Parish, 80 miles west of Morgan City. FEMA reported that over 2,000 flood claims were filed as a result of the storm in Louisiana. These claims had a total value of over $25 million.

Tropical Storm Isidore and Hurricane Lili. On October 3, 2002, one week after Tropical Storm Isidore affected the southeastern and south central coastal areas of Louisiana, Hurricane Lili made landfall on the western edge of Vermilion Bay south of the cities of Abbeville and New Iberia as a weak Category 2 hurricane. The high winds caused tidal flooding in the communities east of the eye of the storm.

Insured flood losses from Tropical Storm Isidore and Hurricane Lili totaled nearly $600 million. Approximately $105 million of insured losses were related to Tropical Storm Isidore, while Hurricane Lili caused $471 million of insured losses. According to windshield surveys conducted by the American Red Cross, approximately 10,000 residential structures were damaged by winds and storm surges of the two storms. These surveys included both insured and uninsured structures. Tropical Storm Isidore caused damage to 2,905 structures, while Hurricane Lili caused damage to 7,356 structures.

In a revised report released in mid-November by the Louisiana State University Agricultural Center (LSU AgCenter), the estimated agricultural damages caused by Tropical Storm Isidore and Hurricane Lili totaled $454.3 million. This estimate also includes the agricultural damages caused by the continuation of rain during the month of October, which delayed the harvesting of crops. The excessive rains and storm surge flooded the agricultural fields and increased the harvest costs.

Hurricane Katrina. On August 29, 2005, Hurricane Katrina made landfall near the town of Buras in Plaquemines Parish about 50 miles east of coastal Lafourche and Terrebonne parishes. While the storm entered as a Category 3 with winds in excess of 120 mile per hour, its storm surge of approximately 30 feet was more characteristic of a Category 5 hurricane. The majority of the damages from Hurricane Katrina occurred outside of the West Shore Lake Pontchartrain study area. However, if the hurricane had taken a more westerly track, the study area could have experienced the same magnitude of flooding as the city of New Orleans.

According to the Department of Health and Hospitals, approximately 1,400 deaths were reported following Hurricane Katrina. Approximately 1.3 million residents were displaced immediately following the storm, and 900,000 residents remained displaced as of October 5, 2005.

The storm caused more than $40.6 billion of insured losses to the homes, businesses, and vehicles in six states. Approximately two thirds of these losses, or $25.3 billion, occurred in Louisiana based on data obtained from the Insurance Information Institute. According to the Louisiana Recovery Authority, approximately 150,000 housing units were damaged, and according to the Department of Environmental Quality, 350,000 vehicles, and 60,000 fishing and recreational vessels were damaged.

According to the LSU AgCenter, agricultural losses totaled approximately $825 million. The agricultural resources impacted by the storm include sugarcane, cotton, rice, soybeans, timber, pecans, citrus, and livestock. The losses to aquaculture (crawfish, alligators, and turtles), fisheries (shrimp, oysters, and menhaden), and wildlife and recreational resources totaled approximately $175 million.

Hurricane Rita. The hurricane made landfall along the Texas-Louisiana border on September 24, 2005, as a Category 3 storm with winds in excess of 120 miles per hour. A storm surge of approximately 15 to 20 feet affected Coastal Louisiana from Terrebonne Parish to the Texas border. With estimated insured losses of approximately $3 billion, Hurricane Rita became one of the most costly natural disasters in U.S. history.

Approximately 2,000 square miles of farmland and marshes throughout the coastal area were inundated from storm surge and associated rainfall with the tropical event. According to the LSU AgCenter, agricultural losses totaled approximately $490 million. The agricultural resources impacted by the storm include sugarcane, cotton, rice, soybeans, timber, pecans, citrus, and livestock. The losses to aquaculture (crawfish, alligators, and turtles), fisheries (shrimp, oysters, and menhaden), and wildlife and recreational resources totaled approximately $100 million.

Hurricanes Gustav and Ike. On September 1, 2008, almost exactly three years after Hurricane Katrina, Hurricane Gustav made landfall near Cocodrie in Terrebonne Parish as a strong Category 2 hurricane. It followed a northwest path into central Louisiana, and most of the damages caused by the storm resulted from its high winds and heavy rain. Coastal flooding occurred in the low lying areas of Jefferson and Lafourche Parishes and the coastal areas of Terrebonne Parish south of the City of Houma.

Nearly 2 million residents of South Louisiana evacuated in the days before Gustav made landfall. Louisiana officials reported that emergency spending totaled approximately $500 million, which included $210 million for state agencies, $48 million for deploying the National Guard, $13.5 million for general evacuation shelters, $3 million for special-needs medical shelters, $6.1 million for transporting the medical needy, $21 million for costs of contraflow and evacuation from coastal communities and other areas, $20 million in special generators to open ice plants, pharmacies and service stations throughout the impacted areas, $5 million for state-purchased fuel, $19.7 million for ready-to-eat meals, $5.3 million for ice, and $2.5 million for water supplies. The State Department of Transportation estimated that it cost approximately $50 million to remove 1.5 million cubic yards of debris, and approximately $20 million to repair draw bridges.

Almost two weeks later, on September 12 and 13, the Louisiana coastal region incurred additional flood damages as Hurricane Ike moved along the Louisiana coast. According to estimates from the state officials, approximately 12,000 homes and businesses were flooded by the two storms. Approximately 2,500 buildings in Terrebonne Parish south of the City of Houma incurred flood damages from Hurricane Ike.

The LSU AgCenter estimated that potential lost revenues and damages to the infrastructure of the agriculture, forestry, and fisheries industries in Louisiana resulting from the two hurricanes totaled approximately $959 million. The storm surge primarily affected the cattle, rice, soybeans, and sugarcane.

Hurricane Isaac. On 29 August 2012, exactly seven years to the day after Hurricane Katrina, Southeast Louisiana was impacted by Hurricane Isaac. The storm made landfall near the mouth of the Mississippi River as a minimal Category 1 hurricane. It then reentered the Gulf of Mexico and made a second landfall near Port Fourchon, Louisiana. Hurricane Isaac produced 45 hours of tropical force winds from the south and southeast as it slowly tracked west of the city of New Orleans. The wind speed and track, combined with slow forward motion, large maximum wind radius, and intense rainfall, produced high storm surges and water elevations throughout coastal Louisiana. Substantial flooding occurred in areas outside federal levee systems, including, but not limited to Slidell, Mandeville, Madisonville, LaPlace, Braithwaite, and Lafitte. In the study area, the hurricane flooded approximately 7,000 structures in the area of LaPlace. The flood claims attributed to Hurricane Isaac in St. John Parish were approximately $226,810,360. This figure is based on 3,332 flood claims reported by FEMA which does not include households obtaining flood insurance.

FEMA Flood Claims. The study area has been impacted by numerous tropical events during the past several decades. According to FEMA data, flood claims for the three parishes in the West Shore-Lake Pontchartrain evaluation area that were paid between 1978 and December 2012 totaled $338 million: $100 million in St. Charles Parish, $236 million in St. John the Baptist Parish, and $1.74 million in St. James

Parish. **Table 8** shows the insurance payments between 1978 and December 2012 for each of the parishes in the study area. It should be noted that these claims are due to both excessive rainfall and storm surges associated with tropical events.

Table 8: FEMA Flood Claims by Parish
West Shore Lake Pontchartrain, LA Feasibility Study
1978-2012

Parish	Number of Claims December 2012	Total Nominal Dollar Amount (in millions)	Average Dollar Amount per Claim (in thousands)
St. Charles	5907	$ 100.13	$ 16.95
St. James	135	$ 1.74	$ 12.87
St. John the Baptist	4851	$ 236.18	$ 48.69
Total	**10893**	**$ 338.05**	**$ 31.03**

Source: FEMA

SCOPE OF THE STUDY

Problem Description. The exposure of the study area to coastal storm surge was made apparent by Hurricane Isaac (August 2012). Approximately 7,000 structures in the study area were damaged and the I-10 and I-55 transportation routes were impassable for 6 days after the storm had passed. The damages and response times during Hurricane Isaac were exacerbated due to standing water for days after the event.

Project Alternatives. Alignment A consists of 20.41 miles of earthen levee which begins at the West Guide levee of the Bonne Carre Spillway. It extends west around the interstate interchange and along the wet/dry interface.

Alternative C follows the same alignment as Alternative A between the West Guide levee of the Bonnet Carre Spillway to the US-51 Interchange where it tracks north across US-51. It consists of 18.27 miles of earthen levees and a T-wall.

Both Alternative A and C will implement non-structural measures which include elevation of structures and acquisition by government in the western portion of the study area.

Alternative D is a westward continuation of Alternative C along the I-10 corridor into Ascension Parish. At the St. James' Parish line, Alternative D continues west just slightly north of I-10 until it reaches Old New River where it will proceed north to a non-federal levee in Ascension Parish (Laurel Ridge Levee). There is no non-structural feature involved in this alternative.

PART 2: ECONOMIC AND ENGINEERING INPUTS TO THE HEC-FDA MODEL

HEC-FDA MODEL

Model Overview. The Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA) Version 1.2.5a Corps-certified model was used to calculate the damages and benefits for the West Shore Lake Pontchartrain evaluation. The economic and engineering inputs necessary for the model to calculate damages for existing conditions (2012), the project base year (2020), and the final year in the period of analysis (2070) include structure inventory, future development, contents-to-structure value ratios, vehicles, first floor elevations, and depth-damage relationships, ground elevations, and without-project stage probability relationships.

The uncertainty surrounding each of the economic and engineering variables was also entered into the model. Either a normal probability distribution, with a mean value and a standard deviation, or a triangular probability distribution, with a most likely, a maximum and a minimum value, was entered into the model to quantify the uncertainty associated with the key economic variables. A normal probability distribution was entered into the model to quantify the uncertainty surrounding the ground elevations. The number of years that stages were recorded at a given gage was entered for each study area reach to quantify the hydrologic uncertainty or error surrounding the stage-probability relationships.

ECONOMIC INPUTS TO THE HEC-FDA MODEL

Structure Inventory. Field surveys were completed in 2012 (prior to Hurricane Isaac) to develop a residential and non-residential structure inventory for the economic analysis. Based on the structural information collected during the field surveys, the Marshall and Swift Valuation Service was used to calculate a depreciated replacement cost for all residential and non-residential structures in the study area reaches. The inventoried structures were classified as one of 14 structure types: residential one-story with slab or pier foundation, residential two-story with slab or pier foundation, mobile home, eating and recreation, grocery and gas station, multi-family residence, professional building, public and semi-public building, repairs and home use establishment, retail and personal services building, and warehouse, and contractor services building. **Table 9** shows the number of structures by structure category and the total number of vehicles associated with the residential structures for existing conditions (2012) for each study area reach or HEC-FDA model station number. The value of the land was not included in the analysis.

Table 9: Number of Structures in the Existing Condition
West Shore Lake Pontchartrain, LA Feasibility Study
(2012)

Reach Name	HEC-FDA Station Number	Residential	Mobile Home	Non-Residential
Total		18,470	1,488	1,882

Future Development Inventory. Projections were made of the future residential and non-residential development to take place in the West Shore Lake Pontchartrain study area under without-project conditions. Based on a pattern of historical development, a total of 565 residential and 149 non-residential structures were placed on the undeveloped land within the study area reaches as part of the structure inventory for the year 2020. An additional 10,428 residential and 679 non-residential structures were added to the inventory for the year 2020 to obtain the structure inventory for the year 2070.

The development projected to occur in each study area reach between the year 2012 and the year 2020 was placed at an elevation equal to the stage associated with the 2020 without-project one percent annual chance exceedance (1% ACE) (100-year) event, unless the ground elevation was higher. The projected development occurring after the year 2020 was placed at an elevation equal to the stage associated with the without-project 1% ACE (100-year) event for the year 2070, unless the ground elevation was higher. The values for the projected residential and non-residential structures were assigned using the average value calculated for each structure category based on the 2012 existing development.

Table 10 shows the number of structures in each structure category and the average depreciated replacement values for (2012 price level) existing conditions. **Table 11** shows the projected number of structures in each structure category for the future years 2020 and 2070, respectively. The value of the land was not included in the analysis.

Table 10: Residential and Non-Residential Structure Inventory
West Shore Lake Pontchartrain, LA Feasibility Study
Existing Conditions (2012)
(2012 price levels in 1000's)

Structure Category	Number	Average Depreciated Replacement Value
Residential		
One-Story Slab	11,532	$ 166
One-Story Pier	4,551	$ 91
Two-Story Slab	2,236	$ 186
Two-Story Pier	151	$ 171
Mobile Home	1,488	$ 14
Total Residential	**19,958**	
Eating and Recreation	128	$ 223
Professional	310	$ 646
Public and Semi-Public	402	$ 972
Repair and Home Use	74	$ 158
Retail and Personal Services	258	$ 368
Warehouse	543	$ 249
Grocery and Gas Station	78	$ 286
Multi-Family Occupancy	86	$ 307
Industrial	3	$ 2,568
Total Non-Residential	**1,882**	

Table 11: Number of Projected Residential and Non-Residential Structures

West Shore Lake Pontchartrain, LA Feasibility Study

Future Conditions (2020)	
Structure Category	Number
Residential	
One-Story Slab	312
One-Story Pier	63
Two-Story Slab	23
Two-Story Pier	5
Mobile Home	162
Total Residential	**565**
Non-Residential	
Eating and Recreation	11
Professional	27
Public and Semi-Public	32
Repair and Home Use	5
Retail and Personal Services	18
Warehouse	48
Grocery and Gas Station	5
Multi-Family Occupancy	3
Industrial	0
Total Non-Residential	**149**
Future Conditions (2070)	
Structure Category	Number
Residential	
One-Story Slab	5,745
One-Story Pier	1,206
Two-Story Slab	394
Two-Story Pier	91
Mobile Home	2,992
Total Residential	**10,428**
Non-Residential	
Eating and Recreation	54
Professional	120
Public and Semi-Public	133
Repair and Home Use	30
Retail and Personal Services	85
Warehouse	217
Grocery and Gas Station	23
Multi-Family Occupancy	17
Industrial	0
Total Non-Residential	**679**

Residential and Non-Residential Content-to-Structure Value Ratios. On-site interviews were conducted with the owners of a sample of ten structures from each of the three residential content categories (30 residential structures) and each of the eight non-residential content categories (80 non-residential structures). As shown in **Table 12**, a CSVR was computed for each residential and non-residential structure in the sample based on the total depreciated content value developed from the surveys. An average CSVR for each of the five residential structure categories and nine commercial structure classifications was calculated as the average of the individual structure CSVRs.

Table 12: Content-to-Structure Value Ratios (CSVRs) and Standard Deviations (SDs) by Structure Category

West Shore Lake Pontchartrain, LA Feasibility Study

Structure Category		(CSVR, SD)
Residential	One-story	(0.65,0.21)
	Two-story	(0.78,0.21)
	Mobile home	(0.60,0.24)
Non-Residential	Eating and Recreation	(1.14,0.48)
	Groceries and Gas Stations	(1.17,0.61)
	Professional Buildings	(0.43,0.14)
	Public and Semi-Public Buildings	(1.14,0.71)
	Multi-Family Buildings	(0.37,0.14)
	Repair and Home Use	(2.06,1.02)
	Retail and Personal Services	(1.42,0.93)
	Warehouses and Contractor Services	(1.68,0.98)

Vehicle Inventory. Based on 2000 Census block group data for the evaluation area, it was determined that there are an average of 1.64 vehicles associated with each household (owner occupied housing or rental unit). According to the Southeast Louisiana Evacuation Behavioral Report published in 2006 following Hurricanes Katrina and Rita, approximately 70 percent of privately owned vehicles are used for evacuation during storm events. The remaining 30 percent of the privately owned vehicles remain parked at the residences and are subject to flood damages. Using the Manheim Used Vehicle Value Index, which is based on over 4 million annual automobile transactions adjusted to reflect retail replacement value, each vehicle was assigned an average value of $12,879 at the 2012 price level. Since only those vehicles not used for evacuation can be included in the damage calculations, an adjusted average vehicle value of $6,723 ($12,879 x 1.74 x 0.30) was assigned to each individual residential structure record in the HEC-FDA model. If an individual structure had more than one housing unit, then the adjusted vehicle value was assigned to each housing unit in a residential or multi-family structure category.

First Floor Elevations and Elevation of Vehicles. Topographical data obtained from the Light Detection and Ranging (LIDAR) digital elevation model (DEM) using the NAVD88 (2004.65 epoch) were used to determine ground elevations. Field survey teams estimated the height of each residential and non-residential structure above the ground using hand levels. The ground elevation was added to the height of the foundation of the structure above the ground in order to determine the first floor elevation of the structure. Vehicles were assigned to the ground elevation of the adjacent residential structures.

Depth-Damage Relationships. Site-specific saltwater, long duration (approximately one week) depth-damage relationships, developed by a panel of building and construction experts for a separate study in Jefferson and Orleans Parishes, were used in the economic analysis. The Jefferson Orleans study area is adjacent to West Shore Lake Pontchartrain study area, approximately 25 miles to the east. These curves indicate the percentage of the total structure value that would be damaged at various depths of flooding. Damage percentages were determined for each one-half foot increment from one-half foot below first floor elevation to two feet above first floor, and for each one-foot increment from 2 feet to 15 feet above first floor elevation. The panel of experts developed depth-damage relationships for five residential structure categories and for three commercial structure categories. Depth-damage relationships were also developed for three residential content categories and eight commercial content categories.

The depth-damage relationships for vehicles were developed based on interviews with the owners of automobile dealerships that had experienced flood damages and were used to calculate flood damages to vehicles at the various levels of flooding.

Table 13 shows the residential and non-residential depth-damage relationships developed for structures, contents, and vehicles. More specific data regarding the depth-damage relationships can be found in the final report in support of Jefferson and Orleans Flood Control Feasibility Study (June 1996).

Uncertainty Surrounding the Economic Inputs. The uncertainty surrounding the four key economic variables was quantified and entered into the HEC-FDA model. These economic variables included structure values, contents-to-structure value ratios, first floor elevations, and depth-damage relationships. The HEC-FDA model used the uncertainty surrounding these variables to estimate the uncertainty surrounding the stage-damage relationships developed for each study area reach.

Structure and Vehicle Values. In order to quantify the uncertainty surrounding the values calculated for the residential and non-residential structure inventory, several survey teams valued an identical set of structures from various evaluation areas in the Gulf Coast region. The structure values calculated by each of the teams during windshield surveys were used to develop a mean value and a standard deviation for each structure in the sample. The standard deviation was then expressed as a percentage of the mean value for that structure. The average standard deviation as a percentage of the mean for the sampled structures was then used to represent the uncertainty surrounding the structure value for all the inventoried residential and non-residential structures. The average standard deviation, which was expressed as a percentage of the mean structure value, totaled 13.85 percent for residential structures and 10.52 percent for non-residential structures.

The uncertainty surrounding the values assigned to the vehicles in the inventory was determined using a triangular probability distribution function. The Manheim vehicle value, adjusted for number of vehicles per household and for the evacuation of vehicles prior to a storm event, was used as the most likely value. The average value of a new vehicle before taxes, license, and shipping charges was used as the maximum value, while the average 10-year depreciation value of a vehicle was used as the minimum value.

Table 13: Depth-Damage Relationships for Structures, Contents and Vehicles

West Shore Lake Pontchartrain, LA Feasibility Study

Occupancy Type	Category Name	Damage Type	Parameter																					
1STY-PIER	Residential		Stage	-1.1	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Structure	Mean %	0.0	4.0	5.4	20.5	62.4	62.4	64.0	65.6	65.6	68.7	71.9	71.9	71.9	71.9	84.4	84.4	84.4	84.4	84.4	84.4	84.4
			Lower %	0.0	1.5	1.5	7.5	40.5	41.5	41.6	44.7	44.7	44.7	46.3	46.3	46.3	46.3	80.0	80.0	80.0	80.0	80.0	80.0	80.0
			Upper %	0.0	9.5	9.5	33.5	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	94.0	100.0	100.0	100.0	100.0	100.0	100.0
		Contents	Mean %	0.0	0.0	0.0	0.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0
			Lower %	0.0	0.0	0.0	0.0	54.6	60.9	65.6	73.9	75.7	81.8	82.4	84.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0
			Upper %	0.0	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1STY-SLAB	Residential		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Structure	Mean %	0.0	0.0	0.0	7.2	56.4	56.4	58.7	58.7	58.7	63.4	66.4	66.4	66.4	66.4	82.1	82.1	82.1	82.1	82.1	82.1	
			Lower %	0.0	0.0	0.0	0.0	36.5	36.5	38.0	38.0	38.0	41.0	61.0	61.0	61.0	61.0	75.4	75.4	75.4	75.4	75.4	75.4	
			Upper %	0.0	0.0	9.5	14.5	63.4	63.4	66.0	66.0	66.0	71.3	72.5	72.5	72.5	72.5	100.0	100.0	100.0	100.0	100.0	100.0	
		Contents	Mean %	0.0	0.0	0.0	0.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	
			Lower %	0.0	0.0	0.0	0.0	54.6	60.9	65.6	73.9	75.7	81.8	82.4	84.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	
			Upper %	0.0	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
2STY-PIER	Residential		Stage	-1.1	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Structure	Mean %	0.0	4.0	4.7	17.5	53.6	53.6	54.4	55.2	55.2	56.8	59.9	59.9	59.9	63.1	71.2	72.8	72.8	74.4	74.4	74.4	74.4
			Lower %	0.0	1.1	1.3	6.4	38.7	38.7	39.3	39.8	39.8	41.0	43.3	43.3	43.3	43.3	45.6	51.4	68.5	68.5	70.0	70.0	70.0
			Upper %	0.0	7.9	8.1	28.6	67.0	67.0	68.0	69.0	69.0	70.9	74.9	74.9	74.9	74.9	78.8	89.0	89.0	89.0	89.0	89.0	89.0
		Contents	Mean %	0.0	0.0	0.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	
			Lower %	0.0	0.0	0.0	66.2	66.2	68.9	68.9	69.2	70.1	80.6	80.8	81.0	86.6	88.2	88.4	88.4	88.7	88.7	88.9	89.0	
			Upper %	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
2STY-SLAB	Residential		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Structure	Mean %	0.0	0.0	5.1	44.2	44.2	45.1	46.0	49.7	51.6	51.6	51.6	51.6	51.6	55.7	66.2	68.0	68.0	69.9	69.9	69.9	
			Lower %	0.0	0.0	0.0	31.9	31.9	32.6	33.3	35.9	37.3	37.3	37.3	37.3	37.3	40.2	47.8	64.0	64.0	65.8	65.8	65.8	
			Upper %	0.0	0.0	7.6	55.2	55.2	56.4	57.6	62.2	64.5	64.5	64.5	64.5	64.5	69.6	82.7	82.7	82.7	82.7	82.7	82.7	
			Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Contents	Mean %	0.0	0.0	0.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	
			Lower %	0.0	0.0	0.0	66.2	66.2	68.9	68.9	69.2	70.1	80.6	80.8	81.0	86.6	88.2	88.4	88.4	88.7	88.7	88.9	89.0	
			Upper %	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
AUTO	AUTO		Stage	0.0	0.5	1.0	1.5	2.0	3.0															
		Structure	Mean %	0.0	2.3	22.8	54.2	95.8	100.0															
			Lower %	0.0	0.0	2.0	50.0	75.0	100.0															
			Upper %	0.0	5.0	50.0	75.0	100.0	100.0															
EAT	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	

		Structure	Mean %	0.0	0.0	3.5	36.5	36.8	36.8	41.1	41.1	48.5	48.5	48.5	49.5	49.5	65.0	65.0	72.5	75.0	77.8	77.8	77.8	
			Lower %	0.0	0.0	0.0	24.3	28.6	29.4	32.0	33.6	41.5	42.0	42.0	42.9	44.3	59.3	59.7	66.5	68.8	74.7	75.7	75.7	
			Upper %	0.0	0.0	7.0	41.0	41.3	41.3	46.1	46.1	54.5	58.2	58.2	58.2	58.2	79.2	79.2	88.3	91.4	94.8	94.8	94.8	
		Contents	Mean %	0.0	0.0	0.0	61.6	82.6	87.3	88.4	93.3	93.5	93.5	93.5	93.5	99.3	99.3	99.3	99.3	99.3	99.3	99.3	99.3	
			Lower %	0.0	0.0	0.0	41.6	62.6	67.3	68.4	73.3	73.5	73.5	73.5	73.5	79.3	79.3	79.3	79.3	79.3	79.3	79.3	79.3	
			Upper %	0.0	0.0	0.0	81.6	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
GROC	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Structure	Mean %	0.0	0.0	3.5	36.5	36.8	36.8	41.1	41.1	48.5	48.5	48.5	49.5	49.5	65.0	65.0	72.5	75.0	77.8	77.8	77.8	
			Lower %	0.0	0.0	0.0	24.3	28.6	29.4	32.0	33.6	41.5	42.0	42.0	42.9	44.3	59.3	59.7	66.5	68.8	74.7	75.7	75.7	
			Upper %	0.0	0.0	7.0	41.0	41.3	41.3	46.1	46.1	54.5	58.2	58.2	58.2	58.2	79.2	79.2	88.3	91.4	94.8	94.8	94.8	
		Contents	Mean %	0.0	0.0	0.0	82.5	97.5	97.8	99.1	99.4	99.7	99.7	99.7	99.7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
			Lower %	0.0	0.0	0.0	77.5	92.5	9.3	94.1	94.4	94.7	94.7	94.7	94.7	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	
			Upper %	0.0	0.0	0.0	87.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
MOBHOM	MOBHOME		Stage	-1.1	-1.0	-0.5	0.0	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Structure	Mean %	0.0	12.1	12.1	32.1	62.1	63.8	64.2	66.3	66.3	66.3	66.3	66.3	66.3	66.3	66.3	66.3	66.3	66.3	66.3	66.3	
			Lower %	0.0	10.1	10.9	29.6	57.4	59.3	59.7	62.2	62.2	62.2	62.2	62.2	62.2	62.2	62.2	62.2	62.2	62.2	62.2	62.2	
			Upper %	0.0	13.4	15.1	34.6	66.8	68.3	68.7	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8	
		Contents	Mean %	0.0	0.0	0.0	0.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	
			Lower %	0.0	0.0	0.0	0.0	47.5	52.0	59.6	73.7	77.6	88.8	89.1	89.4	93.0	93.0	93.0	93.0	93.0	93.0	93.0	93.0	
			Upper %	0.0	0.0	0.0	0.0	95.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
MULT	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Structure	Mean %	0.0	0.0	3.5	36.5	36.8	36.8	41.1	41.1	48.5	48.5	48.5	49.5	49.5	65.0	65.0	72.5	75.0	77.8	77.8	77.8	
			Lower %	0.0	0.0	0.0	24.3	28.6	29.4	32.0	33.6	41.5	42.0	42.0	42.9	44.3	59.3	59.7	66.5	68.8	74.7	75.7	75.7	
			Upper %	0.0	0.0	7.0	41.0	41.3	41.3	46.1	46.1	54.5	58.2	58.2	58.2	58.2	79.2	79.2	88.3	91.4	94.8	94.8	94.8	
		Contents	Mean %	0.0	0.0	0.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	100.0	100.0	100.0	100.0	100.0	
			Lower %	0.0	0.0	0.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	80.0	80.0	80.0	80.0	80.0	
			Upper %	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
PROF	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Structure	Mean %	0.0	0.0	3.5	36.5	36.8	36.8	41.1	41.1	48.5	48.5	48.5	49.5	49.5	65.0	65.0	72.5	75.0	77.8	77.8	77.8	
			Lower %	0.0	0.0	0.0	24.3	28.6	29.4	32.0	33.6	41.5	42.0	42.0	42.9	44.3	59.3	59.7	66.5	68.8	74.7	75.7	75.7	
			Upper %	0.0	0.0	7.0	41.0	41.3	41.3	46.1	46.1	54.5	58.2	58.2	58.2	58.2	79.2	79.2	88.3	91.4	94.8	94.8	94.8	
		Contents	Mean %	0.0	0.0	0.0	98.5	98.5	98.5	98.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
			Lower %	0.0	0.0	0.0	78.5	78.5	78.5	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	
			Upper %	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
PUBL	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	

		Structure	Mean %	0.0	0.0	3.5	36.5	36.8	36.8	41.1	41.1	48.5	48.5	48.5	49.5	49.5	65.0	65.0	72.5	75.0	77.8	77.8	77.8
			Lower %	0.0	0.0	0.0	24.3	28.6	29.4	32.0	33.6	41.5	42.0	42.0	42.9	44.3	59.3	59.7	66.5	68.8	74.7	75.7	75.7
			Upper %	0.0	0.0	7.0	41.0	41.3	41.3	46.1	46.1	54.5	58.2	58.2	58.2	58.2	79.2	79.2	88.3	91.4	94.8	94.8	94.8
		Contents	Mean %	0.0	0.0	0.0	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	100.0	100.0	100.0	100.0	100.0	100.0
			Lower %	0.0	0.0	0.0	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	85.0	85.0	85.0	85.0	85.0	85.0
			Upper %	0.0	0.0	0.0	75.2	75.2	75.2	75.2	75.2	75.2	75.2	75.2	75.2	75.2	75.2	100.0	100.0	100.0	100.0	100.0	100.0
REPA	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Structure	Mean %	0.0	0.0	3.5	36.5	36.8	36.8	41.1	41.1	48.5	48.5	48.5	49.5	49.5	65.0	65.0	72.5	75.0	77.8	77.8	77.8
			Lower %	0.0	0.0	0.0	24.3	28.6	29.4	32.0	33.6	41.5	42.0	42.0	42.9	44.3	59.3	59.7	66.5	68.8	74.7	75.7	75.7
			Upper %	0.0	0.0	7.0	41.0	41.3	41.3	46.1	46.1	54.5	58.2	58.2	58.2	58.2	79.2	79.2	88.3	91.4	94.8	94.8	94.8
		Contents	Mean %	0.0	0.0	0.0	87.5	87.5	87.5	87.5	98.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
			Lower %	0.0	0.0	0.0	67.5	67.5	67.5	67.5	78.9	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
			Upper %	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
RETA	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Structure	Mean %	0.0	0.0	3.5	36.5	36.8	36.8	41.1	41.1	48.5	48.5	48.5	49.5	49.5	65.0	65.0	72.5	75.0	77.8	77.8	77.8
			Lower %	0.0	0.0	0.0	24.3	28.6	29.4	32.0	33.6	41.5	42.0	42.0	42.9	44.3	59.3	59.7	66.5	68.8	74.7	75.7	75.7
			Upper %	0.0	0.0	7.0	41.0	41.3	41.3	46.1	46.1	54.5	58.2	58.2	58.2	58.2	79.2	79.2	88.3	91.4	94.8	94.8	94.8
			Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Contents	Mean %	0.0	0.0	0.0	99.4	99.5	99.7	99.8	99.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
			Lower %	0.0	0.0	0.0	79.4	79.5	79.7	79.8	79.9	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
			Upper %	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
WARE	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Structure	Mean %	0.0	0.0	3.5	36.5	36.8	36.8	41.1	41.1	48.5	48.5	48.5	49.5	49.5	65.0	65.0	72.5	75.0	77.8	77.8	77.8
			Lower %	0.0	0.0	0.0	24.3	28.6	29.4	32.0	33.6	41.5	42.0	42.0	42.9	44.3	59.3	59.7	66.5	68.8	74.7	75.7	75.7
			Upper %	0.0	0.0	7.0	41.0	41.3	41.3	46.1	46.1	54.5	58.2	58.2	58.2	58.2	79.2	79.2	88.3	91.4	94.8	94.8	94.8
			Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Contents	Mean %	0.0	0.0	0.0	36.1	53.0	61.5	69.9	79.5	96.3	97.0	97.0	97.0	97.0	97.0	97.0	97.0	97.0	97.0	97.0	97.0
			Lower %	0.0	0.0	0.0	1.1	18.0	26.5	34.9	44.5	61.3	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0
			Upper %	0.0	0.0	0.0	71.1	88.0	96.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Content-to-Structure Value Ratios. On-site interviews were conducted with the owners of a sample of ten structures from each of the three residential content categories (30 residential structures) and each of the eight non-residential content categories (80 non-residential structures). A CSVR was computed for each residential and non-residential structure in the sample based on the total depreciated content value developed from these interviews. The mean and standard deviation values for each residential and non-residential category were entered into the HEC-FDA model. The model used a normal probability density function to describe the uncertainty surrounding the CSVR for each content category. The expected values and standard deviations are shown for each of the three residential categories and the eight non-residential categories in the final report dated June 1996 entitled *Depth-Damage Relationships for Structures, Contents, and Vehicles and Content-to-Structure Value Ratios (CSVRs) in support of the Jefferson and Orleans Flood Control Feasibility Studies*.

First Floor Elevations. The topographical data used to estimate the first floor elevations assigned to the structure inventory contain two sources of uncertainty. The first source of uncertainty arises from the use of the 2009 LIDAR data, and the second source of uncertainty arises from the use of hand levels to determine the structure foundation heights above ground elevation. The error implicit in using LIDAR data to estimate the ground elevation of each of the inventoried structures is normally distributed with a mean of zero and a standard deviation of 0.6 feet. According to the Hydrologic Engineering Center training manual, and the uncertainty implicit in estimating foundation heights using hand levels from within 50 feet of the structure is normally distributed with a mean of zero and a standard deviation of 0.3 feet at the 95 percent level of confidence.

Depth-Damage Relationships. A triangular probability density function was used to determine the uncertainty surrounding the damage percentage associated with each depth of flooding. A minimum, maximum and most likely damage estimate was provided by a panel of experts for each depth of flooding. The specific range of values regarding probability distributions for the depth-damage curves can be found in the final report dated June 1996 entitled *Depth-Damage Relationships for Structures, Contents, and Vehicles and Content-to-Structure Value Ratios (CSVRs)in Support of the Jefferson and Orleans Flood Control Feasibility Studies*.

ENGINEERING INPUTS TO THE HEC-FDA MODEL

Ground Elevations. Geospatial Engineering acquired elevation data for the West Shore Lake Pontchartrain study area. The LIDAR data were processed and used to create a digital elevation model (DEM) with a five-foot by five-foot horizontal grid resolution. The DEM used NAVD88 2004.65 vertical datum to determine the ground elevations for each of the residential and non-residential structures in the evaluation area.

Stage-Probability Relationships. Stage-probability relationships were provided for the existing (2012) without-project condition and future without-project conditions (2020 and 2070). The stage probability relationships for the year 2070 included low, intermediate and high relative sea level rise scenarios. Water surface profiles were provided for eight annual chance exceedance (ACE) events: 99% (1-year), 20% (5-year), 10% (10-year), 4% (25-year), 2% (50-year), 1% (100-year), 0.5% (200-year), and 0.2% (500-year). The water surface profiles were based only on storm surge and did not incorporate heavy rainfall events.

The 99% ACE (1-year) event, 20% ACE (5-year) event, and 10% ACE (10-year) event water surface profiles for the year 2012 were based on gage data. For each of these ACE events, the water surface profiles for the years 2020 and 2070 were determined by adding relative sea level rise to the gage data. The water surface profiles for the 2% ACE (50-year) event through the 0.2% ACE (500-year) event were based on results from the ADCIRC model. The 4% ACE (25-year) event stages were determined by interpolation between the 10% ACE (10-year) event stages and the 2% ACE (50-year) event stages.

Uncertainty Surrounding the Engineering Inputs. The uncertainty surrounding two key engineering parameters was quantified and entered into the HEC-FDA model. These engineering variables included ground elevations and the stage-probability curves. The HEC-FDA model used the uncertainty surrounding these variables to estimate the uncertainty surrounding the elevation of the storm surges for each study area reach.

Ground Elevations. An engineering survey was conducted to estimate the uncertainty surrounding the use of the 2009 LIDAR data to estimate ground elevations in urbanized areas. A combination of the uncertainty surrounding the ground elevations and the foundation height (0.9 feet) of a residential and non-residential structure was discussed in the first floor elevation uncertainty section of this report.

Stage-Probability Relationships. A 50-year equivalent record length was used to quantify the uncertainty surrounding the stage-probability relationships for each study area reach.

Based on this equivalent record length, the HEC-FDA model calculated the confidence limits surrounding the stage-probability functions.

PART 3: NATIONAL ECONOMIC DEVELOPMENT (NED) FLOOD DAMAGE AND BENEFIT CALCULATIONS

NED FLOOD DAMAGE AND BENEFIT CALCULATIONS FOR STRUCTURES, CONTENTS, AND VEHICLES

HEC-FDA Model Calculations. The HEC-FDA model was utilized to evaluate flood damages using risk-based analysis. Damages were reported at the index location for each of the 81 study area reaches for which a structure inventory had been conducted. A range of possible values, with a maximum and a minimum value for each economic variable (first floor elevation, structure and content values, and depth-damage relationships), was entered into the HEC-FDA model to calculate the uncertainty or error surrounding the elevation-damage, or stage-damage, relationships. The model also used the number of years that stages were recorded at a given gage to determine the hydrologic uncertainty surrounding the stage-probability relationships.

The possible occurrences of each variable were derived through the use of Monte Carlo simulation, which used randomly selected numbers to simulate the values of the selected variables from within the established ranges and distributions. For each variable, a sampling technique was used to select from within the range of possible values. With each sample, or iteration, a different value was selected. The number of iterations performed affects the simulation execution time and the quality and accuracy of the results. This process was conducted simultaneously for each economic and hydrologic variable. The resulting mean value and probability distributions formed a comprehensive picture of all possible outcomes.

Stage-Damage Relationships with Uncertainty. The HEC-FDA model used the economic and engineering inputs to generate a stage-damage relationship for each structure category in each study area reach under existing (2012) and future (2020 and 2070) conditions. The possible occurrences of each economic variable were derived through the use of Monte Carlo simulation. A total of 1,000 iterations were executed by the model for the West Shore Lake Pontchartrain evaluation. The sum of all sampled values was divided by the number of samples to yield the expected value for a specific simulation. A mean and standard deviation was automatically calculated for the damages at each stage.

Stage-Probability Relationships with Uncertainty. The HEC-FDA model used an equivalent record length (50 years) for each study area reach to generate a stage-probability relationship with uncertainty for the without-project condition under existing (2012) and future (2020 and 2070) conditions through the use of graphical analysis. The model used the eight stage-probability events together with the equivalent record length to define the full range of the stage-probability or stage-probability functions by interpolating between the data points. Confidence bands surrounding the stages for each of the probability events were also provided.

Without-Project Expected Annual Damages. The model used Monte Carlo simulation to sample from the stage-probability curve with uncertainty. For each of the iterations within the simulation, stages were simultaneously selected for the entire range of probability events. The sum of all damage values divided by the number of iterations run by the model yielded the expected value, or mean damage value, with confidence bands for each probability event. The probability-damage relationships are integrated by weighting the damages corresponding to each magnitude of flooding (stage) by the percentage chance of

exceedance (probability). From these weighted damages, the model determined the expected annual damages (EAD) with confidence bands (uncertainty). For the without-project alternative, the expected annual damages (EAD) were totaled for each study area reach to obtain the total without-project EAD under existing (2012) and future (2020 and 2070) conditions. **Table 14** shows the Expected Annual Damages for structures, contents and vehicles for 2012, 2020 and the three relative sea level rise scenarios in the year 2070. **Table 15** shows the number and type of structure that is damaged by each of annual chance exceedance events for the years 2020 and 2070 using the intermediate relative sea level rise scenario.

Table 14: Expected Annual Damage (1,000's) Structure, Contents and Vehicles
West Shore Lake Pontchartrain, LA Feasibility Study

Analysis Year	Without- Project Damages	Percent Increase from 2012
2012	$ 44,331	
2020	$ 59,027	33%
2070 low sea level rise	$ 183,819	315%
2070 intermediate sea level rise	$ 266,933	502%
2070 high sea level rise	$ 590,067	1231%

Table 15: Number of Structures Receiving Damages by Probability Event in 2020 and 2070 Intermediate Sea Level Rise Residential, Commercial, and Mobile Homes Unadjusted Without-Project Condition

West Shore Lake Pontchartrain, LA Feasibility Study

Annual Chance Exceedance Event (ACE)	Residential	Non-Residential	Mobile Home	Total
Base year 2020				
0.99 (1 yr)	53	3	-	
0.20 (5 yr)	80	5	-	
0.10 (10 yr)		63	26	
0.04 (25 yr)		159	113	
0.02 (50 yr)		373	316	
0.01 (100 yr)		555	525	
0.005 (200 yr)		824	656	
0.002 (500 yr)		1,039	812	
Future year 2070 Intermediate Sea Level Rise				
0.99 (1 yr)	312	58	15	385
0.20 (5 yr)	552	95	64	711
0.10 (10 yr)	2,010	293	210	2,513
0.04 (25 yr)	4,862	456	338	5,656
0.02 (50 yr)	11,242	1,234	897	13,373
0.01 (100 yr)	17,296	1,524	1,207	20,027
0.005 (200 yr)	20,766	2,189	1,353	24,308
0.002 (500 yr)	26,113	2,373	1,524	30,010

Note: The table reflects the number of structures damaged by ACE event before adjustments were made to the structure inventory for repetitive flooding.

Equivalent Annual Damages. Damages for each of the years during the period of analysis were computed by linear interpolation between 2020 and 2070. The FY 2013 Federal interest rate of 3.75 percent was used to compound the stream of expected annual damages and benefits before the project base year and to discount the stream of expected annual damages and benefits occurring after the base year to calculate the total present value of the damages over the period of analysis. The present value of the expected annual damages was then amortized over the period of analysis using the Federal discount rate to calculate the equivalent annual damages. **Table 16** shows the equivalent annual without-project damages for each of the study area reaches using projected intermediate relative sea level rise.

Screening to Tentatively Selected Plan. Utilizing existing data, current and future without-project damages and parametric costs, the alternatives were screened based on the 1 percent or 100-year level of risk reduction. The alternatives are expected to provide the same level of risk reduction therefore the alternatives were screened based on costs. For Alternatives A and C to provide the same benefits, structure raisings or acquisitions will be offered in the area not receiving risk reduction by structural measures. The combination of the structural measure for Alternative A and Alternative C with a non-structural measure is equal to the risk reduction provided by the longer structural alignment, Alternative D.

Using the damage probability relationship from the HEC-FDA model for the top ten damage reaches, it was estimated that a 1 percent project would eliminate damages for the 25, 50 and 100-year events. The three alternatives would not eliminate damages from rainfall at the more frequent events (1 and 10 year events) and the less frequent events (200 and 500 year events). While benefits from structure elevation would accrue in the more frequent events, the reaches offering structure elevation were not in the top ten. Extrapolating the percent reduction in damages for the top ten damage reaches, 46 percent, to the remainder of the study area, the 2020 estimated benefits are estimated to be $27.7 million. If the 46 percent reduction is equally applicable to 2070 intermediate relative sea level rise damages, then the benefits are estimated to be $122.3 million. This increase is reflective of the intermediate rise level rise scenario only.

The expected annual estimated benefits for 2020 and 2075 were converted to an equivalent annual value using the current interest rate, 3.75 percent, and a 50-year period of analysis. The total cost for the project alternatives included the construction costs along with the costs of non-structural measures in the western portion of the study area. This cost was applied to Alternatives A and C since they provide the same level of risk reduction using the 1 percent (100-year) level of risk reduction. **Tables 17, 18 and 19** show the calculation of the estimated annual cost for the alternatives using the 3.75 percent interest rate and a 50-year period of analysis. **Tables 20, 21, and 22** show the estimated equivalent annual benefits, annual costs, and equivalent annual net benefits. The net benefit results show that the project alternatives are economically justified for the 1% (100-year) annual exceedance probability (AEP) system under the intermediate sea-level rise scenario. The results were obtained using parametric costs and adjustments to the without project damages to reflect the expected project performance.

Table 16: Annual Without Project Damages for Each Study Area Reach

West Shore Lake Pontchartrain, LA Feasibility Study

Equivalent Annual Damage Analysis

File Help

WSLP 2020
Equivalent Annual Damage by Damage Categories and Damage Reaches
for the Without (Without project condition) plan
(Damage in $1,000's)

Discount Rate: 3.750
Analysis Period: 50 Years
Plan was calculated with Uncertainty

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Equivalent Annual Damage or Damage Categories						Total Damage
				AUTO	COM	IND	MOBHOM	MOBHOME	RES	
Westshore	Stream added d	SA 18	SA 18	1.11	54.39	0.00	0.00	0.00	0.00	55.50
		SA 9	SA 9	25.92	475.39	0.00	5.83	0.00	1088.51	1595.65
		SA 1	SA 1	17.74	222.74	0.00	5.51	0.00	354.12	600.11
		SA 2	SA 2	27.33	198.88	0.00	9.24	0.00	419.20	654.66
		SA 3	SA 3	0.80	13.52	0.00	0.26	0.00	5.09	19.67
		SA 4	SA 4	14.30	77.65	0.00	3.50	0.00	282.40	377.85
		SA 5	SA 5	3.62	15.75	0.00	1.83	0.00	68.92	90.12
		SA 6	SA 6	3.33	12.29	0.00	0.28	0.00	49.13	65.03
		SA 7	SA 7	34.66	61.86	0.00	38.92	0.00	339.75	475.18
		SA 8	SA 8	59.37	284.05	0.00	17.53	0.00	1713.56	2074.50
		SA 10	SA 10	41.64	1045.75	0.00	14.11	0.00	1104.05	2205.55
		SA 11	SA 11	0.13	7.54	0.00	0.00	0.00	0.00	7.68
		SA 12	SA 12	18.45	300.36	0.00	20.45	0.00	227.36	566.63
		SA 13	SA 13	29.50	229.20	0.00	6.00	0.00	567.45	832.15
		SA 14	SA 14	14.35	533.59	0.00	2.52	0.00	464.21	1014.66
		SA 15	SA 15	10.77	86.51	0.00	2.24	0.00	202.98	302.51
		SA 16	SA 16	43.57	318.84	0.00	114.72	0.00	434.52	911.66
		SA 17	SA 17	0.90	0.00	0.00	0.00	0.00	30.81	31.71
		SA 25	SA 25	1.84	151.11	0.00	0.00	0.00	43.69	196.64
		SA 22	SA 22	17.38	23.15	0.00	13.98	0.00	375.42	429.92
		SA 21	SA 21	116.78	3598.57	0.00	16.94	0.00	2760.41	6492.70
		SA 19	SA 19	0.43	0.79	0.00	0.00	0.00	0.00	1.22
		SA 20	SA 20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		SA 43P	SA 43P	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		SA 42P	SA 42P	0.30	3.52	0.00	0.00	0.00	0.00	3.82
		SA 26	SA 26	1.19	8.05	0.00	0.00	0.00	3.61	12.86
		SA 28Y	SA 28Y	2.32	386.48	0.00	0.00	0.00	0.00	388.80
		SA 29	SA 29	109.11	1747.47	0.00	5.65	0.00	2536.28	4398.52
		SA 30	SA 30	543.67	915.02	0.00	0.00	0.00	15725.93	17184.63
		SA 44C	SA 44C	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		SA 41P	SA 41P	0.20	0.00	0.00	0.00	0.00	7.78	7.98
		SA 40P	SA 40P	7.01	24.98	0.00	0.00	0.00	9.62	41.61
		SA 31	SA 31	225.49	669.75	0.00	0.00	0.00	8206.81	9102.05
		SA 32	SA 32	505.83	414.33	0.00	0.00	0.00	17322.82	18242.99
		SA 41	SA 41	5.70	1037.17	0.00	0.00	0.00	0.00	1042.86
		SA 35	SA 35	71.32	575.09	0.00	0.00	0.00	2353.86	3000.28
		SA 38	SA 38	126.91	28.84	0.00	0.19	0.00	5463.73	5619.66

Equivalent Annual Damage Analysis

File Help

WSLP 2020
Equivalent Annual Damage by Damage Categories and Damage Reaches
for the Without (Without project condition) plan
(Damage in $1,000's)

Discount Rate: 3.750
Analysis Period: 50 Years
Plan was calculated with Uncertainty

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Equivalent Annual Damage or Damage Categories						Total Damage
				AUTO	COM	IND	MOBHOM	MOBHOME	RES	
		SA 38	SA 38	118.31	28.84	0.00	0.19	0.00	5463.89	5611.22
		SA 37	SA 37	0.05	0.00	0.00	0.00	0.00	0.72	0.77
		SA 36	SA 36	41.35	417.69	0.00	0.00	0.00	948.44	1407.48
		SA 27	SA 27	233.41	11299.39	0.00	0.00	0.00	0.00	11532.80
		SA 30C	SA 30C	26.03	0.00	0.00	0.00	0.00	1144.74	1170.78
		SA 23	SA 23	5.04	396.60	0.00	0.08	0.00	34.75	436.46
		SA 24	SA 24	33.75	525.89	0.00	75.50	0.00	152.60	787.74
		SA 28X	SA 28X	32.98	1085.35	0.00	25.59	0.00	284.89	1428.81
		SA 39	SA 39	4.33	89.90	0.00	3.09	0.00	9.98	107.29
		SA 39C	SA 39C	1.78	46.58	0.00	0.20	0.00	40.10	88.67
		SA 34	SA 34	332.56	2678.29	0.00	0.00	0.00	11627.86	14638.71
		SA 33	SA 33	300.72	448.24	0.00	0.00	0.00	8649.61	9398.58
		SA 31C	SA 31C	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		SA 29C	SA 29C	8.09	313.48	0.00	0.00	0.00	92.19	413.75
		1	1	5.03	100.92	0.00	2.31	0.00	112.04	220.30
		2	2	0.07	0.00	0.00	0.00	0.00	0.00	0.07
		3	3	0.08	9.78	0.00	0.00	0.00	0.00	9.86
		4	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		5	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		6	6	0.00	28.89	0.00	0.00	0.00	0.00	28.89
		7	7	66.56	41.99	0.00	0.00	0.00	1803.29	1911.83
		8	8	39.82	454.83	0.00	17.15	0.00	719.79	1231.59
		9	9	0.74	0.80	0.00	0.00	0.00	12.37	13.90
		10	10	0.54	1.69	0.00	0.00	0.00	10.70	12.93
		11	11	35.45	26.89	0.00	0.00	0.00	921.14	983.48
		12	12	0.50	0.24	0.00	0.00	0.00	6.25	6.99
		13	13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		14	14	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		15	15	0.00	0.79	0.00	0.00	0.00	0.01	0.81
		16	16	0.02	0.03	0.00	0.00	0.00	0.27	0.33
		17	17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		18	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		19	19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		20	20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		21	21	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		22	22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		23	23	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Equivalent Annual Damage Analysis

File Help

WSLP 2020
Equivalent Annual Damage by Damage Categories and Damage Reaches
for the Without (Without project condition) plan
(Damage in $1,000's)

Discount Rate: 3.750
Analysis Period: 50 Years
Plan was calculated with Uncertainty

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Equivalent Annual Damage or Damage Categories						Total Damage
				AUTO	COM	IND	MOBHOM	MOBHOME	RES	
		21	21	1.97	366.15	0.00	0.00	0.00	0.00	368.12
		22	22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		23	23	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		24	24	2.99	0.00	0.00	0.00	0.00	184.75	187.74
		25	25	0.03	0.00	0.00	0.00	0.00	0.35	0.38
		26	26	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		27	27	0.24	0.00	0.00	0.00	0.00	23.69	23.93
		28	28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		29	29	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		30	30	0.13	0.04	0.00	0.00	0.00	1.73	1.89
		31	31	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		32	32	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		33	33	0.38	32.93	0.00	0.00	0.00	0.00	33.31
		34	34	0.24	0.00	0.00	0.00	0.00	3.78	4.01
		35	35	0.15	0.00	0.00	0.00	0.00	2.39	2.54
		36	36	0.36	0.00	0.00	0.85	0.00	2.85	4.06
		37	37	2.94	7.15	0.00	0.00	0.00	117.82	127.91
		38	38	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		39	39	0.08	0.00	0.00	0.00	0.00	0.99	1.07
		40	40	0.01	0.00	0.00	0.00	0.00	0.08	0.09
		41	41	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		42	42	0.07	0.05	0.00	0.00	0.00	1.50	1.61
		43	43	0.16	0.12	0.00	0.00	0.00	3.76	4.04
		44	44	0.32	27.76	0.00	0.00	0.00	3.03	31.11
		45	45	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		46	46	39.37	566.60	0.00	83.00	0.00	1050.73	1739.70
		47	47	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		48	48	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		49	49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		50	50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		51	51	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		52	52	0.25	0.44	0.00	0.00	0.00	3.14	3.83
		53	53	7.90	67.28	0.00	5.96	0.00	180.87	262.02
		54	54	9.74	340.05	0.00	0.00	0.00	508.69	858.48
		55	55	16.57	536.02	0.00	2.65	0.00	409.51	964.75
		56	56	25.00	399.98	0.00	5.85	0.00	665.19	1096.03
	Total for stream:			3333.75	34798.68	163.64	502.08	0.00	91891.04	130689.20

Table 17: Alternative C - 1% AEP Total Annual Costs
(2012 Price Level; 3.75% Discount Rate)
West Shore Lake Pontchartrain, LA Feasibility Study
($ Millions)

Year	Years from Base Year	Expenditures	Present Value	Present Value of
2010	-9	$0	1.393	0
2011	-8	$0	1.342	0
2012	-7	$0	1.294	0
2013	-6	$0	1.247	0
2014	-5	$0	1.202	0
2015	-4	$0	1.159	0
2016	-3	$0	1.117	0
2017	-2	$150	1.076	161
2018	-1	$150	1.038	155
2019	0	$150	1.000	150
2020	1	$150	0.964	144
2021	2	$6	0.929	5
2022	3	$6	0.895	5
2023	4	$6	0.863	5
2024	5	$6	0.832	5
2025	6	$6	0.802	5
2026	7	$6	0.773	4
2027	8	$6	0.745	4
2028	9	$6	0.718	4
2029	10	$6	0.692	4
2030	11	$6	0.667	4
2031	12	$6	0.643	4
2032	13	$6	0.620	4
2033	14	$6	0.597	3
2034	15	$6	0.576	3
2035	16	$6	0.555	3
2036	17	$6	0.535	3
2037	18	$6	0.515	3
2038	19	$6	0.497	3
2039	20	$6	0.479	3
2040	21	$6	0.462	3
2041	22	$6	0.445	3
2042	23	$6	0.429	2
2043	24	$6	0.413	2
2044	25	$6	0.398	2
2045	26	$6	0.384	2
2046	27	$6	0.370	2

Table 17 (Cont.) Alternative C - 1% AEP Total Annual Costs

(2012 Price Level; 3.75% Discount Rate)
West Shore Lake Pontchartrain, LA Feasibility Study
($ Millions)

Year	Years from Base Year	Expenditures	Present Value	Present Value of
2047	28	$6	0.357	2
2048	29	$6	0.344	2
2049	30	$6	0.331	2
2050	31	$6	0.319	2
2051	32	$6	0.308	2
2052	33	$6	0.297	2
2053	34	$6	0.286	2
2054	35	$6	0.276	2
2055	36	$6	0.266	2
2056	37	$6	0.256	1
2057	38	$6	0.247	1
2058	39	$6	0.238	1
2059	40	$6	0.229	1
2060	41	$6	0.221	1
2061	42	$6	0.213	1
2062	43	$6	0.205	1
2063	44	$6	0.198	1
2064	45	$6	0.191	1
2065	46	$6	0.184	1
2066	47	$6	0.177	1
2067	48	$6	0.171	1
2068	49	$6	0.165	1
2069	50	$6	0.159	1
		880.901		734

Interest Rate (%)	3.75	
Amortization Factor	0.04457	
Average Annual Costs		32.7
O&M Costs		4.1
Total Average Annual Costs ($ Millions)		36.8

Table 18: Alternative A - 1% AEP Total Annual Costs
(2012 Price Level; 3.75% Discount Rate)
West Shore Lake Pontchartrain, LA Feasibility Study
($ Millions)

Year	Years from Base Year	Expenditures	Present Value	Present Value of
2010	-9	$0	1.393	0
2011	-8	$0	1.342	0
2012	-7	$0	1.294	0
2013	-6	$0	1.247	0
2014	-5	$0	1.202	0
2015	-4	$0	1.159	0
2016	-3	$0	1.117	0
2017	-2	$151	1.076	163
2018	-1	$151	1.038	157
2019	0	$151	1.000	151
2020	1	$151	0.964	146
2021	2	$6	0.929	5
2022	3	$6	0.895	5
2023	4	$6	0.863	5
2024	5	$6	0.832	5
2025	6	$6	0.802	5
2026	7	$6	0.773	4
2027	8	$6	0.745	4
2028	9	$6	0.718	4
2029	10	$6	0.692	4
2030	11	$6	0.667	4
2031	12	$6	0.643	4
2032	13	$6	0.620	4
2033	14	$6	0.597	3
2034	15	$6	0.576	3
2035	16	$6	0.555	3
2036	17	$6	0.535	3
2037	18	$6	0.515	3
2038	19	$6	0.497	3
2039	20	$6	0.479	3
2040	21	$6	0.462	3
2041	22	$6	0.445	3
2042	23	$6	0.429	2
2043	24	$6	0.413	2
2044	25	$6	0.398	2
2045	26	$6	0.384	2
2046	27	$6	0.370	2

Table 18 (Cont.) Alternative A - 1% AEP Total Annual Costs

(2012 Price Level; 3.75% Discount Rate)
West Shore Lake Pontchartrain, LA Feasibility Study
($ Millions)

Year	Years from Base Year	Expenditures	Present Value	Present Value of
2047	28	$6	0.357	2
2048	29	$6	0.344	2
2049	30	$6	0.331	2
2050	31	$6	0.319	2
2051	32	$6	0.308	2
2052	33	$6	0.297	2
2053	34	$6	0.286	2
2054	35	$6	0.276	2
2055	36	$6	0.266	2
2056	37	$6	0.256	1
2057	38	$6	0.247	1
2058	39	$6	0.238	1
2059	40	$6	0.229	1
2060	41	$6	0.221	1
2061	42	$6	0.213	1
2062	43	$6	0.205	1
2063	44	$6	0.198	1
2064	45	$6	0.191	1
2065	46	$6	0.184	1
2066	47	$6	0.177	1
2067	48	$6	0.171	1
2068	49	$6	0.165	1
2069	50	$6	0.159	1
		887.591		741

Interest Rate (%)	3.75	
Amortization Factor	0.04457	
Average Annual Costs		33.0
O&M Costs		7.5
Total Average Annual Costs ($ Millions)		40.5

Table 19: Alternative D - 1% AEP Total Annual Costs
(2012 Price Level; 3.75% Discount Rate)
West Shore Lake Pontchartrain, LA Feasibility Study
($ Millions)

Year	Years from Base Year	Expenditures	Present Value	Present Value of
2010	-9	$0	1.393	0
2011	-8	$0	1.342	0
2012	-7	$0	1.294	0
2013	-6	$0	1.247	0
2014	-5	$0	1.202	0
2015	-4	$0	1.159	0
2016	-3	$0	1.117	0
2017	-2	$223	1.076	240
2018	-1	$223	1.038	231
2019	0	$223	1.000	223
2020	1	$223	0.964	215
2021	2	$0	0.929	0
2022	3	$0	0.895	0
2023	4	$0	0.863	0
2024	5	$0	0.832	0
2025	6	$0	0.802	0
2026	7	$0	0.773	0
2027	8	$0	0.745	0
2028	9	$0	0.718	0
2029	10	$0	0.692	0
2030	11	$0	0.667	0
2031	12	$0	0.643	0
2032	13	$0	0.620	0
2033	14	$0	0.597	0
2034	15	$0	0.576	0
2035	16	$0	0.555	0
2036	17	$0	0.535	0
2037	18	$0	0.515	0
2038	19	$0	0.497	0
2039	20	$0	0.479	0
2040	21	$0	0.462	0
2041	22	$0	0.445	0
2042	23	$0	0.429	0
2043	24	$0	0.413	0
2044	25	$0	0.398	0
2045	26	$0	0.384	0
2046	27	$0	0.370	0

Table 19 (Cont.): Alternative D - 1% AEP Total Annual Costs
(2012 Price Level; 3.75% Discount Rate)
West Shore Lake Pontchartrain, LA Feasibility Study
($ Millions)

Year	Years from Base Year	Expenditures	Present Value	Present Value of
2047	28	$0	0.357	0
2048	29	$0	0.344	0
2049	30	$0	0.331	0
2050	31	$0	0.319	0
2051	32	$0	0.308	0
2052	33	$0	0.297	0
2053	34	$0	0.286	0
2054	35	$0	0.276	0
2055	36	$0	0.266	0
2056	37	$0	0.256	0
2057	38	$0	0.247	0
2058	39	$0	0.238	0
2059	40	$0	0.229	0
2060	41	$0	0.221	0
2061	42	$0	0.213	0
2062	43	$0	0.205	0
2063	44	$0	0.198	0
2064	45	$0	0.191	0
2065	46	$0	0.184	0
2066	47	$0	0.177	0
2067	48	$0	0.171	0
2068	49	$0	0.165	0
2069	50	$0	0.159	0
		891.085		908

Interest Rate (%)	3.75	
Amortization Factor	0.04457	
Average Annual Costs		40.5
O&M Costs		6.2
Total Average Annual Costs ($ Millions)		46.7

Table 20: 1% AEP (100-year) Alternative C
(2012 Price Level; 3.75% Discount Rate)
Total Equivalent Annual Net Benefits
West Shore Lake Pontchartrain, LA Feasibility Study
($ Millions)

Item	Equiv Annual W/O Project Damages (2020-2070)	Equiv Annual With-Project Damages (2020-2070)	Equiv Annual Benefits (2020-2070)
Damage Category			
Residential & Commercial - Structure/Content/Vehicles	$ 130.69	$ 70.80	$ 59.89
First Costs	_	_	$ 881.00
Interest During Construction	_	_	$ 17.00
Annual Operation & Maintenance Costs			$ 4.13
Total Annual Costs			$ 36.80
B/C Ratio			1.63
Equivalent Annual Net Benefits - 2020 Base Year			$ 23.05

Table 21: 1% AEP (100-year) Alternative A
(2012) Price Level; 3.75% Discount Rate
Toal Equivalent Annual Net benefits
West Shore Lake Pontchartrain, Louisiana Feasibility Study
($Millions)

Item	Equiv Annual W/O Project Damages (2020-2070)	Equiv Annual With-Project Damages (2020-2070)	Equiv Annual Benefits (2020-2070)
Damage Category			
Residential & Commercial - Structure/Content/Vehicles	$ 130.69	$ 70.80	$ 59.89
First Costs	_	_	$ 887.59
Interest During Construction	_	_	$ 17.20
Annual Operation & Maintenance Costs			$ 7.51
Total Annual Costs			$ 40.53
B/C Ratio			1.48
Equivalent Annual Net Benefits - 2020 Base Year			$ 19.36

Table 22: 1% AEP (100-year) Alternative D
(2012 Price Level; 3.75% Discount Rate) Total Equivalent Annual Net Benefits
West Shore Lake Pontchartrain, LA Feasibility Study

Item	Equiv Annual W/O Project Damages (2020-2070)	Equiv Annual With-Project Damages (2020-2070)	Equiv Annual Benefits (2020-2070)
Damage Category			
Residential & Commercial - Structure/Content/Vehicles	$ 130.69	$ 70.80	$ 59.89
First Costs	-	-	$ 891.08
Interest During Construction	-	-	$ 25.40
Annual Operation & Maintenance Costs			$ 6.18
Total Annual Costs			$ 46.67
B/C Ratio			1.28
Equivalent Annual Net Benefits - 2020 Base Year			$ 13.22

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

PLAN FORMULATION

APPENDIX E

Contents

INTRODUCTION

This appendix provides supplemental plan formulation information on the West Shore Lake Pontchartrain, Louisiana Hurricane and Storm Damage Risk Reduction Feasibility study. It supplements the information in Chapter 3 of the main report and includes tables and maps used in the development, screening, and evaluation of management measures and alternative plans.

Per the study authority, as identified in Chapter 1, the study area includes portions of St. Charles, St. John the Baptist, and St. James Parishes. It is bounded on the east by the Bonnet Carré Spillway upper guide levee, on the north by Lakes Pontchartrain and Maurepas, on the west by the Ascension/St. James Parish line, and on the south by the Mississippi River Levee (**Figure 1**).

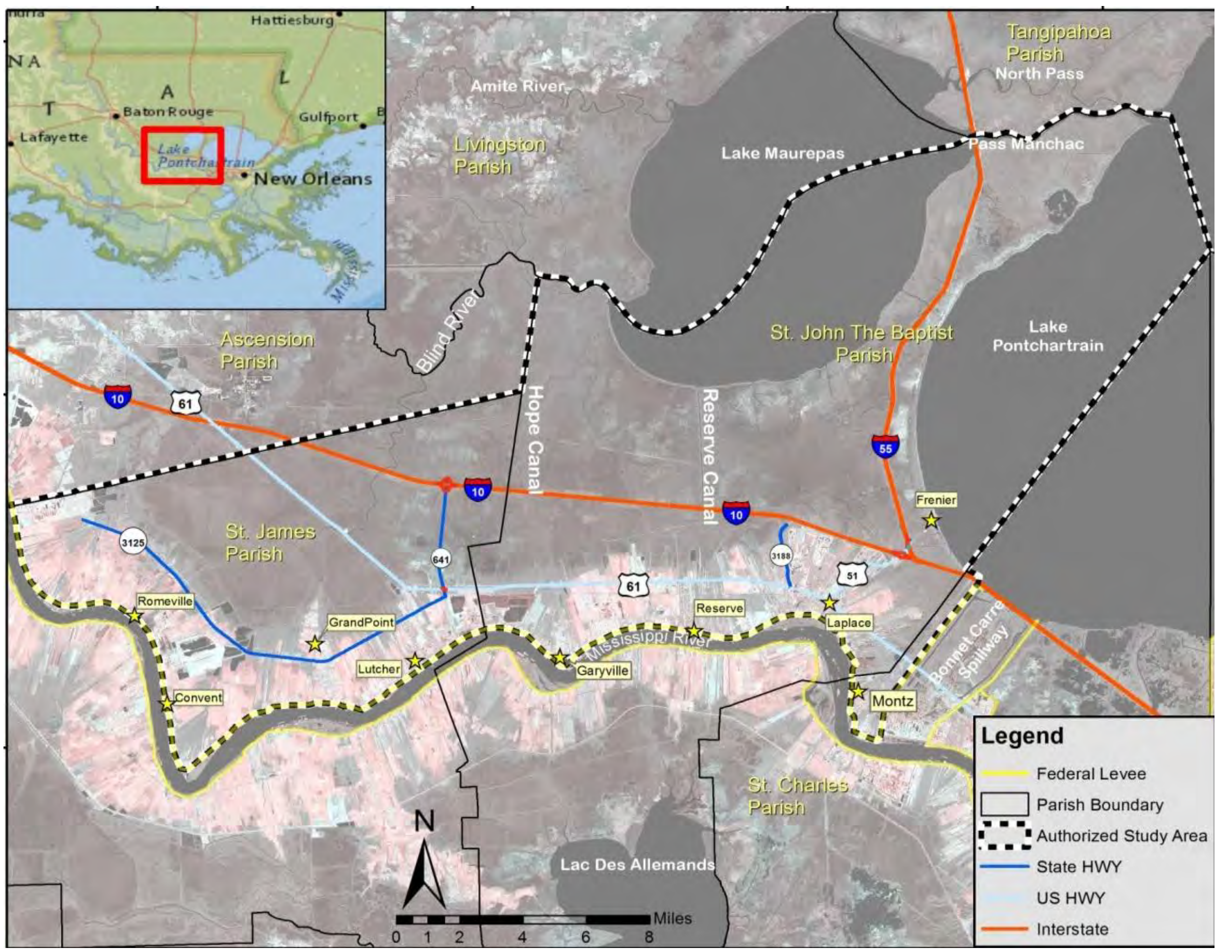


Figure 1: Study Area

The study goals, objectives and constraints are identified in Chapters 1 and 3 of the draft report. They are included as a point of reference for understanding details of the screening process (**Table 1**).

Table 1: Objectives and Constraints

OBJECTIVES	CONSTRAINTS
1. Reduce hurricane storm surge related damages through 2070.	1. Minimize impacts to wetlands.
2. Reduce risk to residents' life and health by decreasing flooding to the maximum extent practical.	2. Minimize impacts to the Small Diversion at Convent/Blind River project and River Reintroduction into Maurepas Swamp Project.
3. Increase public awareness of hurricane risks in developed flood prone areas.	3. No loss of flood protection from existing flood damage risk reduction projects.
4. Enhance public awareness of the risk to life and property of development in flood prone areas.	4. Minimize impacts to the Maurepas Swamp Wildlife Management Area and surrounding wetlands.
5. Reduce the risk of damage and loss of critical infrastructure, specifically the I-10/I-55 hurricane evacuation routes.	5. Minimize infrastructure impacts (pipelines, highways, hospitals, schools, fire stations, and police stations).

MANAGEMENT MEASURES

Measures considered for this study are outlined in **Chapter 3, Section 3.3**. This section provides additional information about the measures that were evaluated and removed from further consideration during the planning process. These measures were screened and evaluated based on their ability to meet the planning objectives while avoiding the study constraints (see **Table 1**). Additional criteria of effectiveness and efficiency were used.

Cypress Reforestation: This measure would enhance and/or restore cypress forest on the Maurepas Landbridge and in the Maurepas Swamp to reduce surge heights. The measure did not meet objectives to reduce the risk of damages to structures and to residents' life and health. Structures would still be damaged from the increased still water levels during storms. Consequently, the measure was screened because it was ineffective. **Figure 2** demonstrates the storm surge flow through cypress vegetation.

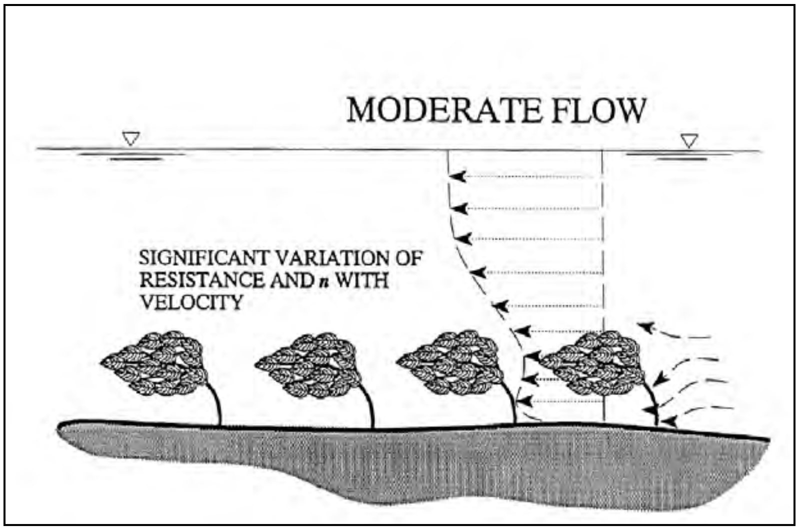


Figure 2: Storm Surge through Vegetation

Seawall: This measure would construct a seawall along the rim of Lakes Maurepas and Pontchartrain. This measure would have adverse impacts to the existing environmental systems and drainage system. This measure would enclose the Maurepas Swamp and would stop water exchanges between Lake Maurepas and the swamp (see **Figure 3**). The mitigation features for this measure would be cost prohibitive. The measure was screened because it was not cost effective.

Figure 3: Seawall Measure

Flood Forecast and Warning: The area has an ample Forecast/Warning System. NOAA, FEMA, and the USACE already take the responsibility of producing the storm surge maps under existing floodplain management authorization.

Floodgates on Tidal Passes: This measure would place a large tide control structure on Pass Manchac, and potentially North Pass, to prevent storm surge from entering the area. It would have adverse impacts to the environment and drainage system. A control structure would restrict tidal flows under normal conditions and limit the upper basin's ability to drain during storms. The mitigation features would be cost prohibitive (inefficient). Additionally, it would be ineffective due to surge flanking.

Highway/Levee: This measure would raise the I-10 roadbed to serve as a levee to reduce risk of surge damage. Using the roadbed as a levee system would require massive changes to the existing highway system. In addition, future levee lifts would require the highway to be replaced at each event.

Control Structures (Canals and Bayous): Control structures were evaluated as both a stand-alone measure and in combination with other measures. It was removed as a standalone measure because at higher storm surge events, surge heights are higher than the existing banks, making a canal closure alone ineffective (see **Figure 4 and 5**). However portions of the feature were carried forward in combination with other measures.

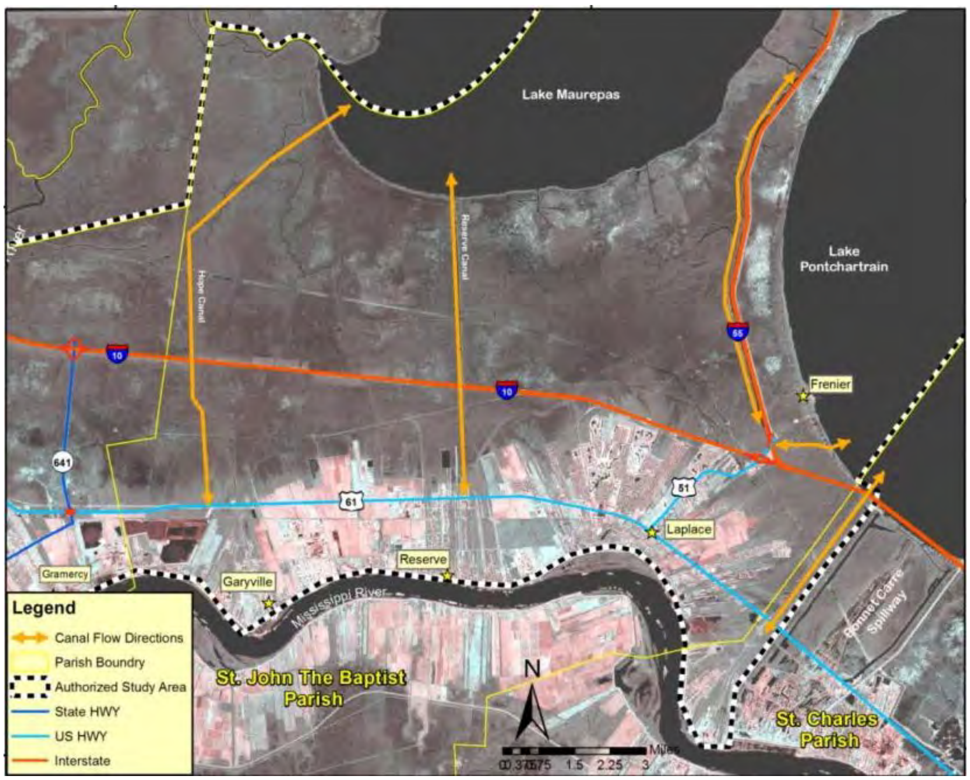


Figure 4: Canal Drainage Patterns

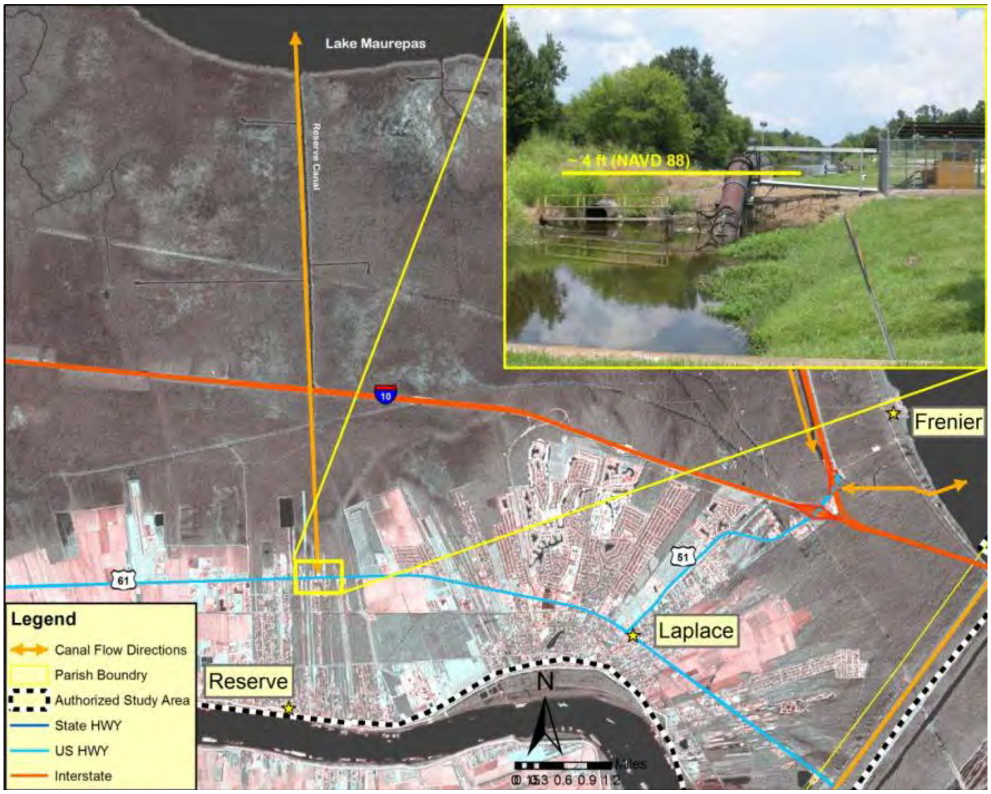


Figure 5: Reserve Canal Cross Section View

INITIAL ARRAY OF ALTERNATIVE PLANS

As discussed in **section 3.4** of the draft report, structural plans developed from earlier study efforts are incorporated into the plan formulation process documented in this report. Structural alternative plans typically included an earthen levee with control structures which extend from the west guide levee of the Bonnet Carré Spillway in St. Charles Parish to various points west in the area. **Table 2** outlines the structural plans considered in this study and **Figures 6 through 17** maps the alignments.

Table 2: Initial Array of Structural Plans

Condensed Plan ID	Linkages to Past WSLP efforts
Plan 1: Spillway to Reserve Canal	1987 Reconnaissance Report: Alignment #2 1997 Reconnaissance Report: Alignment 2 1998 Scoping Report: Alignment #2
Plan 2: Spillway to East St. John High School (ESJ)	1985 Initial Evaluation Report: Alignment #2 1997 Reconnaissance Report: Alignment 1 1998 Scoping Report: Alignment # 1
Plan 3: Spillway to ESJ (wetland/non-wetland)	1997 Reconnaissance Report: Alignment # 5 1998 Scoping Report: Alignment # 3
Plan 4: Spillway to ESJ (I-10 Offset)	1997 Reconnaissance Report: Alignment # 5 1998 Scoping Report: Alignment # 1

Condensed Plan ID	Linkages to Past WSLP efforts
Plan 5: Spillway to Marathon	1997 Reconnaissance Report: Alignment 2 1998 Scoping Report: Alignment #2 2006 Evaluation of Draft FS Report : USACE Plan A 2007 Screening Assessment: Alignment A
Plan 6: Spillway to Reserve (US-51 Protection)	1985 Initial Evaluation Report: Alignment #4 1997 Reconnaissance Report: Alignment 1A/B 1998 Scoping Report: Alignment # 1
Plan 7: Spillway to Marathon (wetland/non-wetland)	1997 Reconnaissance Report: Alignment 1A/B 1998 Scoping Report: Alignment # 1 2006 Evaluation of Draft FS Report : USACE Plan A 2007 Screening Assessment: Alignment A
Plan 8: Spillway to Ascension Parish/MS River	1985 Initial Evaluation Report: Alignment #3 1997 Reconnaissance Report: Alignment 2A/B 2007 Screening Assessment: Alignment D
Plan 9: Spillway to Hope Canal/MS River	1997 Reconnaissance Report: Alignment # 5 2006 Evaluation of Draft FS Report : USACE Plan A 2007 Screening Assessment: Alignment A
Plan 10: Spillway to Hope Canal/MS River (I-10 Protection)	1985 Initial Evaluation Report: Alignment #3 2006 Evaluation of Draft FS Report : St. John Plan B 2007 Screening Assessment: Alignment B
Plan 11: Spillway to Hope Canal/MS River (Pipeline Avoidance)	1985 Initial Evaluation Report: Alignment #1 1987 Reconnaissance Report: Alignment #1 2006 Evaluation of Draft FS Report : St. John Revised 2007 Screening Assessment: Alignment C
Plan 12: Spillway to Ascension Parish (I-10 Protection)	1985 Initial Evaluation Report: Alignment #3 2007 Screening Assessment: Alignment D

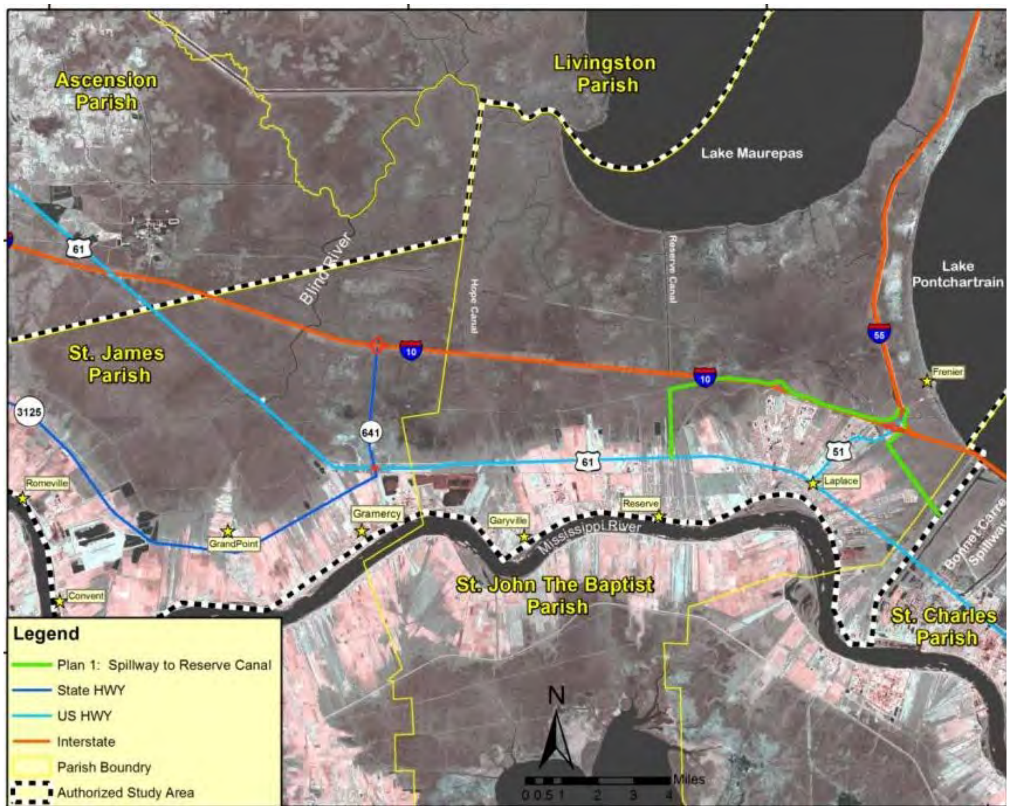


Figure 6: Plan 1 - Bonne Carré Spillway to Reserve Canal

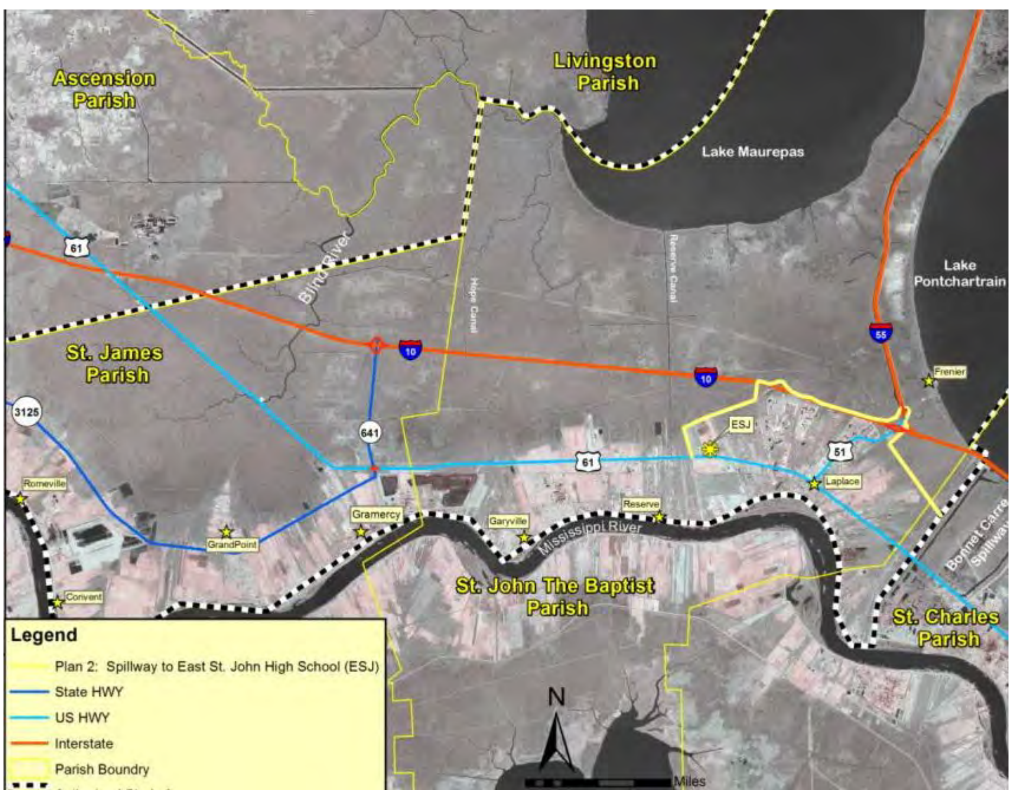


Figure 7: Plan 2 - Bonnet Carré Spillway to East St. John High School

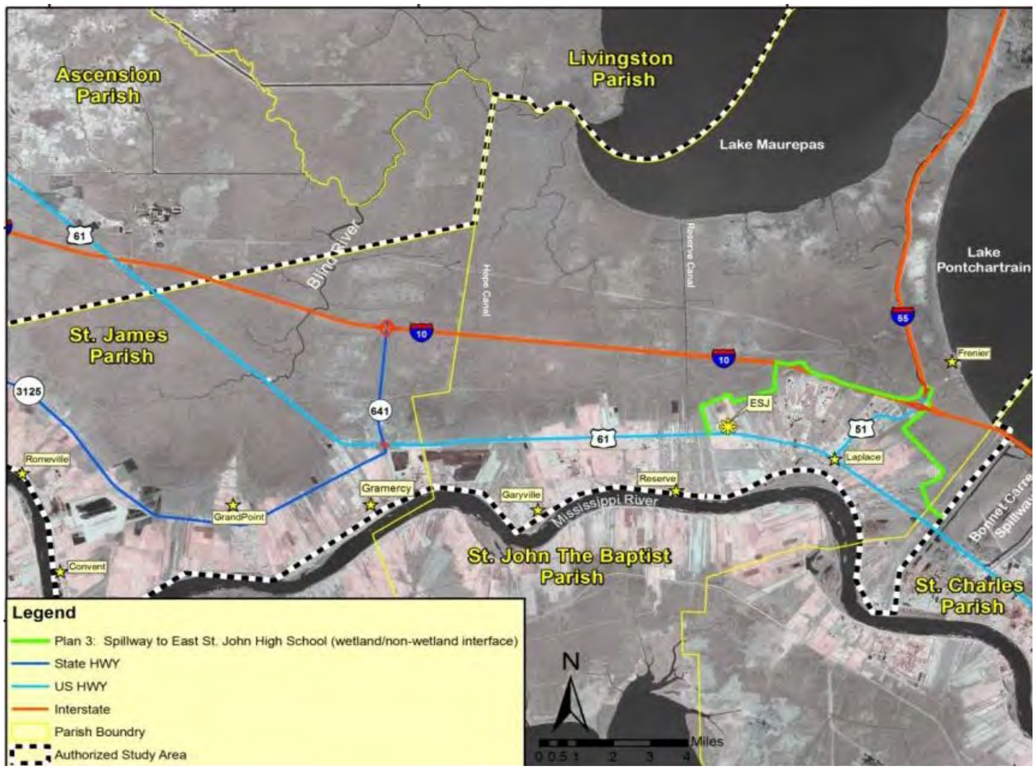


Figure 8: Plan 3 - Bonnet Carré Spillway to East St. John School (wetland interface)

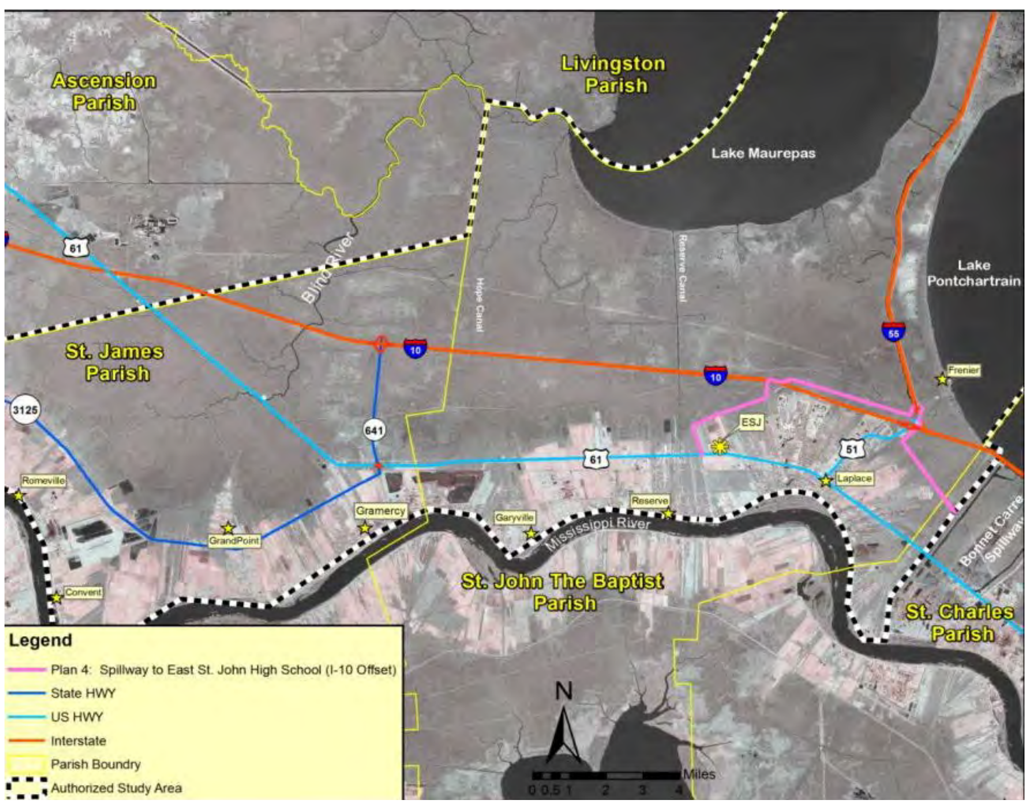


Figure 9: Plan 4 - Bonnet Carré Spillway to East St. John High School (I-10 Offset)

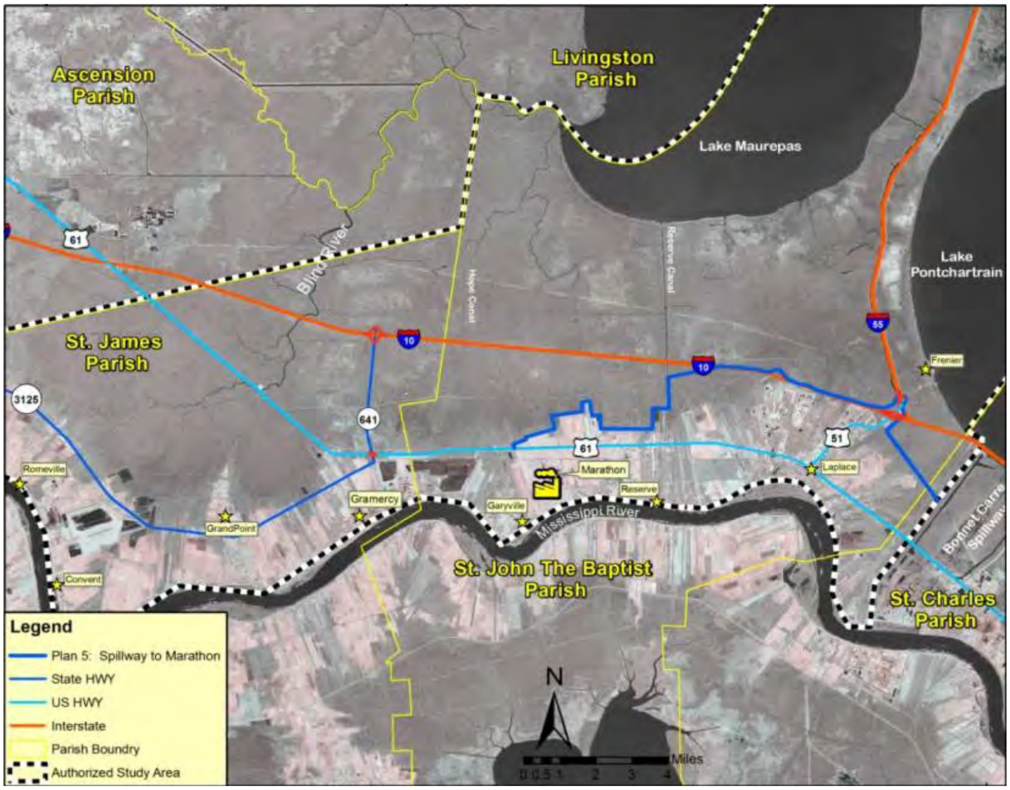


Figure 10: Plan 5 - Bonnet Carré Spillway to Spillway to Marathon

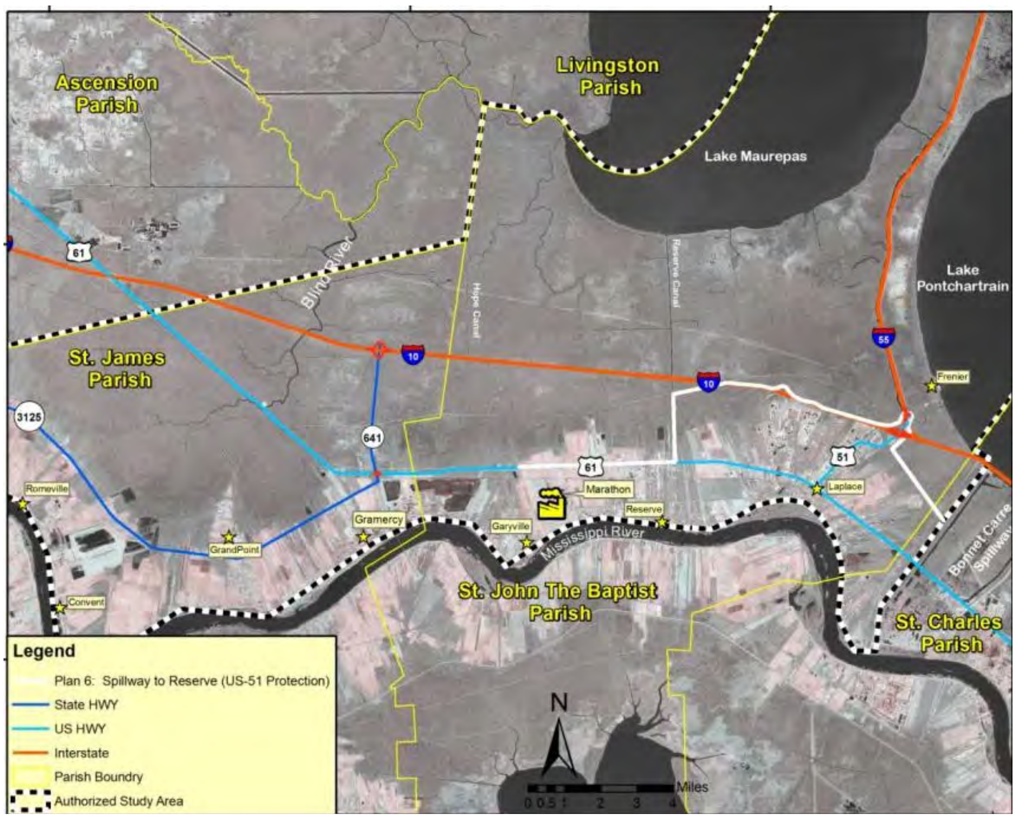


Figure 11: Plan 6 - Bonnet Carré Spillway to Reserve (US-51 Risk Reduction)

Figure 12: Plan 7 - Bonnet Carré Spillway to Marathon (wetland interface)

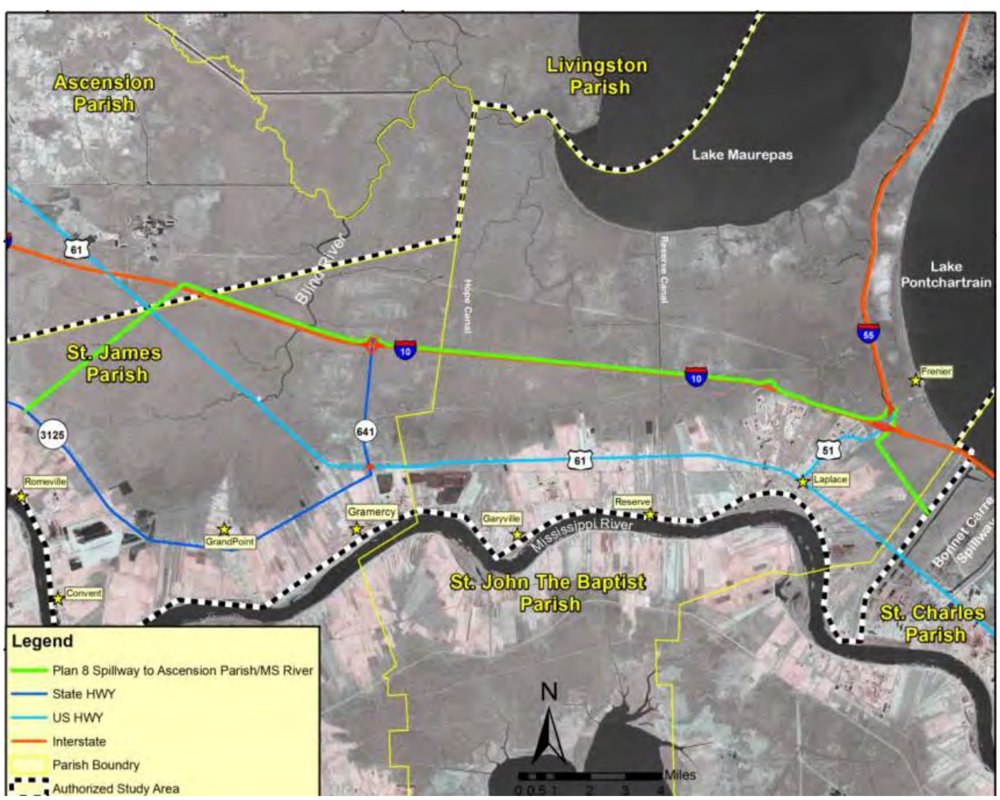


Figure 13: Plan 8 - Bonnet Carré Spillway to Ascension Parish/Mississippi River

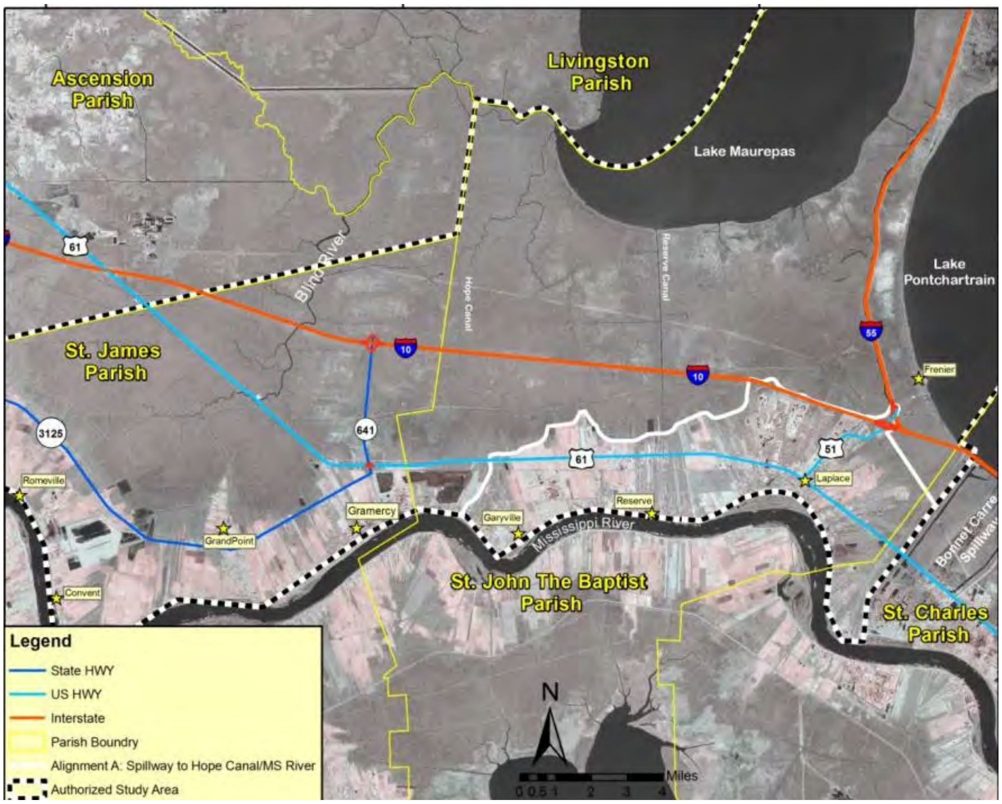


Figure 14: Plan 9 - Bonnet Carré Spillway to Hope Canal/Mississippi River

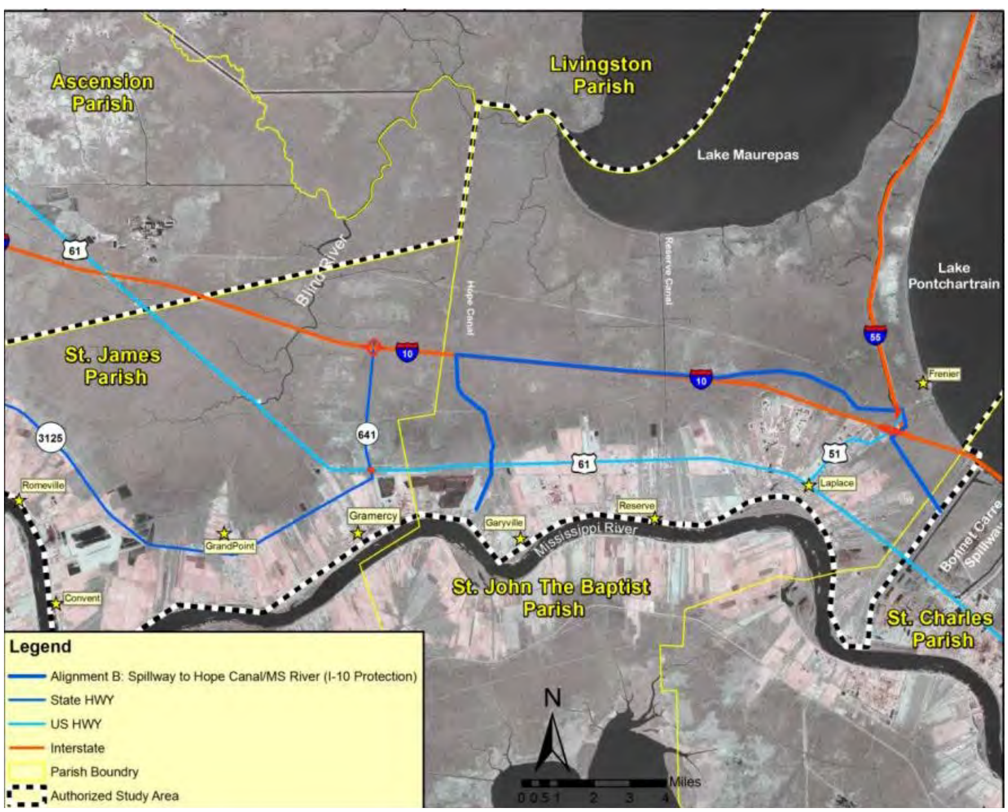


Figure 15: Plan 10 - Bonnet Carré Spillway to Hope Canal/MS River (I-10 Risk Reduction)

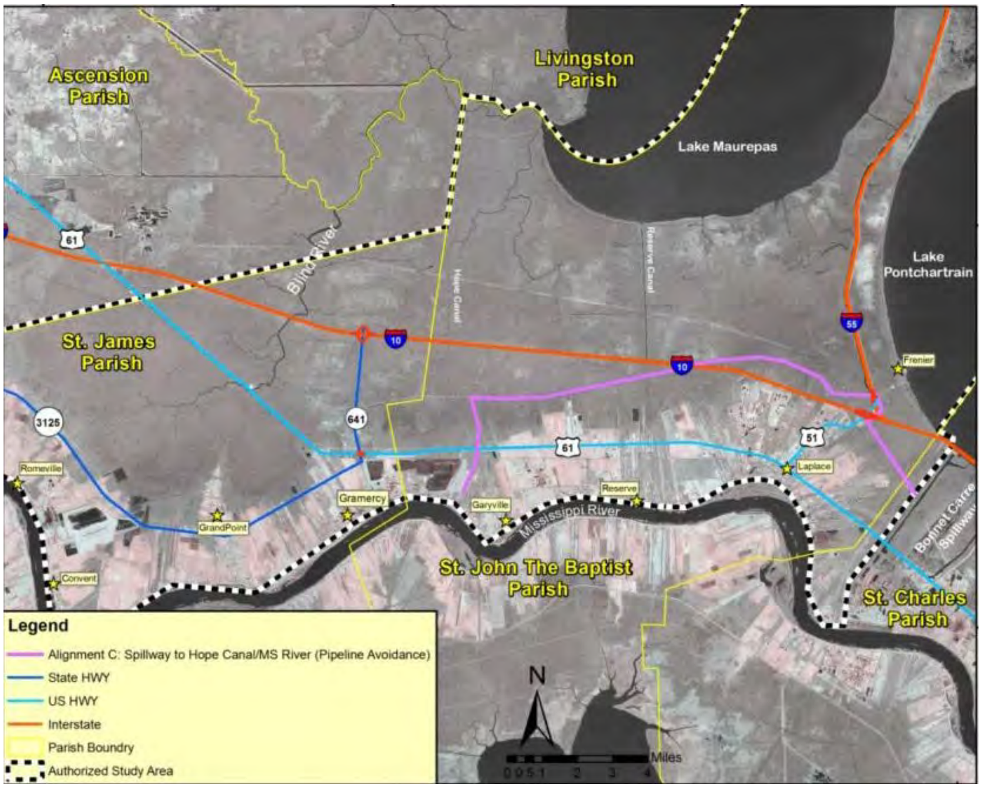


Figure 16: Plan 11 - Bonne Carré Spillway to Hope Canal/MS River (Pipeline Avoidance)

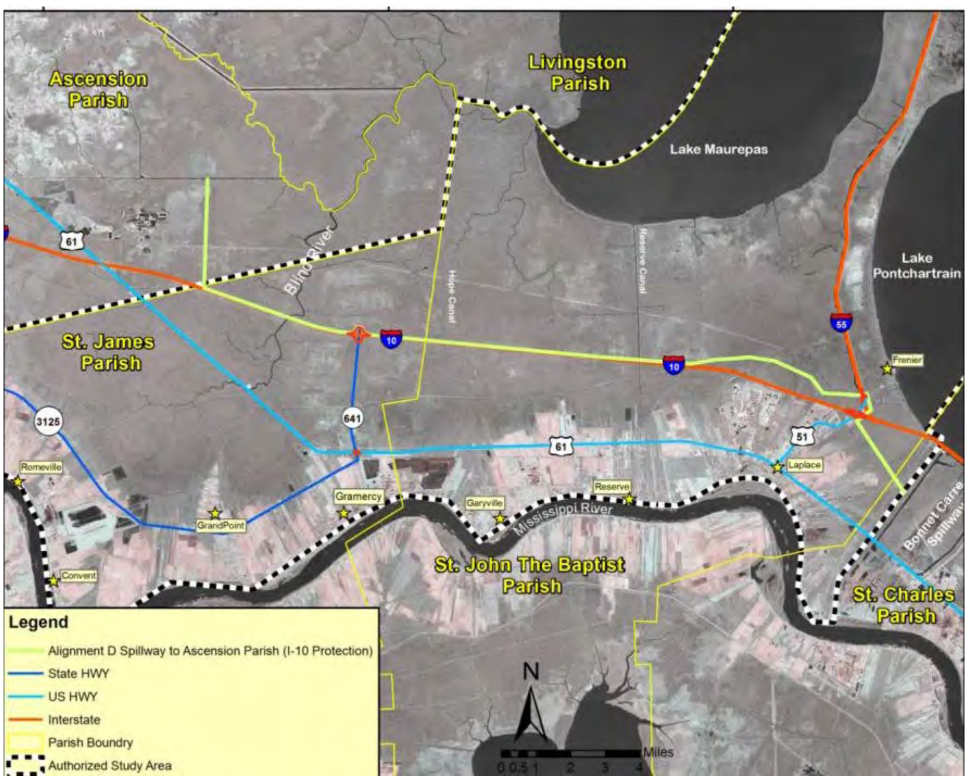


Figure 17: Plan 12 - Bonnet Carré Spillway to Ascension Parish (I-10 Risk Reduction)

Discussion on how the alternative plans were ranked and screened can be found in the draft report in **Chapter 3 Section 3.4**. To determine if plans were viable for further evaluation, plans were scored on how well objectives were met and constraints were avoided **(Table 3)**.

Table 3: Screening and Ranking of Initial Array Plans against Objectives and Constraints

	Objectives Ranked (5=High, 4=Medium High , 3=Medium, 2=Medium-Low 1=Low)			Avoids Constraint (5=High, 4=Medium High , 3=Medium, 2=Medium-Low 1=Low)					
Condensed Plan ID	#1 Storm damages	#2 Reduce risk to life and health	#5 Reduce the risk of damage and loss of critical infrastructure	#1 Min. impacts to wetlands	#2 Min. impacts to diversion projects	#3 No loss of existing flood protection	#4 Avoid impacts to WMA & wetlands	#5 Min. impacts to critical infrastructure	SUM
Plan 11: Spillway to Hope Canal/MS River (Pipeline Avoidance)	4	4	4	3	3	3	3	5	29
Plan 9: Spillway to Hope Canal/MS River	4	4	4	5	4	1	5	1	28
Plan 10: Spillway to Hope Canal/MS River (I-10 Protection)	4	4	4	2	3	3	2	5	27

	Objectives Ranked (5=High, 4=Medium High , 3=Medium, 2=Medium-Low 1=Low)			Avoids Constraint (5=High, 4=Medium High , 3=Medium, 2=Medium-Low 1=Low)					
Condensed Plan ID	#1 Storm damages	#2 Reduce risk to life and health	#5 Reduce the risk of damage and loss of critical infrastructure	#1 Min. impacts to wetlands	#2 Min. impacts to diversion projects	#3 No loss of existing flood protection	#4 Avoid impacts to WMA & wetlands	#5 Min. impacts to critical infrastructure	SUM
Plan 12: Spillway to Ascension Parish (I-10 Protection)	5	4	5	1	1	4	1	4	25
Plan 8: Spillway to Ascension Parish/MS River	5	4	5	1	1	4	2	4	24
Plan 3: Spillway to ESJ (wetland/non-wetland)	2	1	3	5	4	1	5	2	23
Plan 2: Spillway to East St. John High School (ESJ)	2	1	3	4	4	2	4	2	22
Plan 7: Spillway to Marathon (wetland/non-wetland)	2	2	3	4	4	1	4	1	21
Plan 4: Spillway to ESJ (I-10 Offset)	2	1	3	2	4	2	4	3	21

	Objectives Ranked (5=High, 4=Medium High , 3=Medium, 2=Medium-Low 1=Low)			Avoids Constraint (5=High, 4=Medium High , 3=Medium, 2=Medium-Low 1=Low)					
Condensed Plan ID	#1 Storm damages	#2 Reduce risk to life and health	#5 Reduce the risk of damage and loss of critical infrastructure	#1 Min. impacts to wetlands	#2 Min. impacts to diversion projects	#3 No loss of existing flood protection	#4 Avoid impacts to WMA & wetlands	#5 Min. impacts to critical infrastructure	SUM
Plan 5: Spillway to Marathon	3	2	3	2	4	1	4	1	20
Plan 1: Spillway to Reserve Canal	2	1	3	2	4	2	4	2	20
Plan 6: Spillway to Reserve (US-51 Protection)	2	1	2	4	4	1	4	1	20

After reviewing the aggregate scores, Plans 1 - 6 were eliminated from further consideration because they did not maximize the planning objectives. Plans that could induce flooding to communities outside of the risk reduction system or divided communities were eliminated from consideration because they were considered unacceptable.

Descriptions of further analyses and screening are contained in Chapter 3, Sections 3.4 – 3.8.

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX F
REFERENCES

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

Annex A

Acronyms

AAE – Average Annual Equivalent
ADCIRC – Advanced Circulation Model
AEP – Annual Exceedance Probability
ARDC – Amite River Diversion Canal
ASA(CW) – Assistant Secretary of the Army for Civil Works
BCR – Benefit Cost Ratio
BFE – Base Flood Elevation
BLH – Bottomland Hardwood
CAA – Clean Air Act
CBRD – Convent Blind River Diversion
CC – Coefficient of Conservatism
CE – Corps of Engineers
CE/ICA – Cost Effectiveness/ Incremental Cost Analysis
CERCLA – Comprehensive Environmental Response, Compensation and Liability Act, 1980 (Superfund)
CFS – Cubic Feet per Second
CPRAB – Louisiana Coastal Protection and Restoration Authority Board
CRMS – Coastwide Reference Monitoring System
CW – Civil Works
CWA – Clean Water Act, 1977
CY – Cubic Yard
CZMA – Coastal Zone Management Act
DEIS – Draft Environmental Impact Statement
DMD – Daily Mean Freshwater Discharge
DOE – Department of Energy
DOI – Department of the Interior
DOT – Department of Transportation
DQC – District Quality Control
EA – Environmental Assessment
EAD – Expected Annual Damages
EFH – Essential Fish Habitat
EJ – Environmental Justice
EO – Executive Order
ER – Engineering Regulation
ERDC – Engineering Research & Design Center
ESA – Endangered Species Act/Environmental Site Assessment
EQ – Environmental Quality
FWL – Fish and Wildlife
FWOP – Future Without Project
FWP – Future With Project
FCA – Flood Control Act
FCSA – Feasibility Cost Sharing Agreement
FEMA – Federal Emergency Management Agency
FFE – First Floor Elevation/ Finished Floor Elevation
FHWA – Federal Highway Administration
FPMS – Floodplain Management Services
FPPA – Farmland Protection Policy Act
FQI – Floristic Quality Index
FWCA – Fish and Wildlife Coordination Act
FWCAR – Fish and Wildlife Coordination Act Report
GIS - Geographic Information Systems

GIWW – Gulf Inter-Coastal Waterway
H&H – Hydrology and Hydraulics
HEC – Hydrologic Engineering Center
HEP – Habitat Evaluation Procedures
HI – Hydrologic Index
HQUSACE – Headquarters, U. S. Army Corps of Engineers
HSDRRS – Hurricane and Storm Damage Risk Reduction System
HTRW – Hazardous, Toxic, and Radioactive Wastes
HU – Habitat Unit
LCA – Louisiana Coastal Area
LCWCRTF – Louisiana Coastal Wetlands Conservation and Restoration Task Force
LDOTD – Louisiana Department of Transportation and Development
LDWF – Louisiana Department of Wildlife and Fisheries
LERRD – Lands, Easements, Rights-of-Way, Relocations, and Disposal Areas
LNHP – Louisiana Natural Heritage Program
MBTA – Migratory Bird Treaty Act
MHW – Mean High Water
MLW – Mean Low Water
MMPA – Marine Mammal Protection Act
MR&T – Mississippi River and Tributaries
MRC – Mississippi River Commission
MRL – Mississippi River Levee
MVD – Mississippi Valley Division (Vicksburg, MS)
MVN – New Orleans District
NAAQS – National Ambient Air Quality Standards
NAVD – North American Vertical Datum of 1988
NED – National Economic Development
NEPA –National Environmental Policy Act
NFIP – National Flood Insurance Program
NFS – Non-Federal Sponsor
NHPA National Historic Preservation Act
NMFS – National Marine Fisheries Service
NOAA – National Oceanographic and Atmospheric Administration
NORM – Naturally Occurring Radioactive Materials
NPS – National Park Service
NRCS – Natural Resources Conservation Service
NRHP – National Register of Historic Places
NWRC – National Water Resource Center
OCPR – Office of Coastal Protection and Restoration
OMRR&R – Operations, Maintenance, Repair, Rehabilitation and Replacement
OSE – Other Social Effects
OSHA – Occupational Safety and Health Administration
P&G – Principles and Guidelines
PED – Pre-construction Engineering and Design
PLD – Pontchartrain Levee District
QA/QC – Quality Assurance / Quality Control
REC – Recognized Environmental Conditions
RED – Regional Economic Development
REP – Real Estate Plan
RSLR – Relative Sea Level Rise
SAV – Submerged Aquatic Vegetation

SHPO – State Historic Preservation Office
SLC – Sea Level Change
SLR – Sea Level Rise
SMART – Specific Measurable Attainable Risk-Informed Timely
STWAVE – Steady State Spectral WAVE model
SVI – Submergence Vulnerability Index
SWPPP – Stormwater Pollution Prevention Plan
T&E – Threatened and Endangered Species
TMDL -Total Maximum Daily Load
TSP – Tentatively Selected Plan
USACE – United States Army Corps of Engineers
USCG – United States Coast Guard
USDA – United States Department of Agriculture
USEPA – United States Environmental Protection Agency
USFWS – United States Fish and Wildlife Service
USGS – United States Geological Survey
WMA – Wildlife Management Area
WCRA – Wetlands Conservation and Restoration Authority
WRDA – Water Resources Development Act
WSE – Water Surface Elevations
WSLP – West Shore Lake Pontchartrain
WVA – Wetland Value Assessment

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

Annex B

Literature Cited

American Bird Conservancy. 2009. Saving Migratory Birds for Future Generations: The Success of the Neotropical Migratory Bird Conservation Act. American Bird Conservancy. 23pp

American Society of Civil Engineers (ASCE). 2013. Louisiana: Infrastructure report card. www.infrastructurereportcard.org/louisiana/louisiana-overview accessed May 22, 2013.

Atilla, N., N. Rabalais, W. Morrison, W. Mendenhall, C. Normandeau, Q. Dortch., R.E. Turner. 2007. Phytoplanton community Composition in Lake Pontchartrain. Abstract, American Society of Limnology and Oceanography.

Baroch, M.J., M. Hafner, T.L. Brown, J.J. Mach, R.M. Poche. 2002. Nutria (Myocaster coypus) in Louisiana. Wildlife Damage Management, Interment Center for Other Publications in Wildlife Management. http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1045&context=icwdmother#page=4.

Battelle. 2005. Phase 1 Assessment of Potential Water Quality and Ecological Risk and Benefits from a Proposed Reintroduction of Mississippi River Water into the Maurepas Swamp. Prepared for the USEPA, Region 6.

Beyer, G.E., A. Allison, and H.H. Kopman. 1906. List of Birds of Louisiana. University of California Press on behalf of the American Ornithologist's Union.

Broussard, W.P. 2008. A Century of Land Use and Water Quality in Watersheds of the Continental U.S. MS thesis, Louisiana State University, Baton Rouge, Louisiana. http://etd.lsu.edu/docs/available/etd-07072008-182001/. Last accessed on May 28, 2012.

Brown, K.M., G. George, and W. Daniel. 2010. Urbanization and a threatened freshwater mussel: evidence from landscape scale studies. Hydrobiologia 655:189-196.

Council on Environmental Quality (CEQ). 1997. Considering Cumulative Effects Under the National Environmental Policy Act. Council on Environmental Quality.

Conner, W.H., and J.W. Day. 1976. Productivity and Composition of a Baldcypress-Water Tupelo Site and a Bottomland Hardwood Site in a Louisiana Swamp. American Journal of Botany, Vol. 63, No. 10, pp. 1354–1364.

Cretini, K.F., Visser, J.M., Krauss, K.W.,and Steyer, G.D. 2012. Development and use of floristic quality index for coastal Louisiana marshes. Environmental Monitoring and Assessment 184:2389-2403.

Day, J.W., Jr., C.A.S. Hall, W.M. Kemp, A. Yanez-Arancibia. 1989. Estuarine Ecology. John Wiley and Sons, New York. 558 pp.

Demcheck, D.K., R.W. Tollett, S.V. Mize, S.C. Skrobialowski, R.B. Fendick Jr., C.M. Swarzenski, and S. Porter. 2004. Water Quality in the Acadian-Pontchartrain Drainages, Louisiana and Mississippi, 1999-2001. U.S. Geological Survey Circular 1232.

Dundee, H.A., and D.A. Rossman. 1989. The Amphibians and Reptiles of Louisiana. Louisiana State University Press, Baton Rouge.

Farris, G.S., G.J. Smith, M.P. Crane, C.R. Demas, L.L. Robbins, and D.L. Lavoie, eds. 2007. Science and the storms—the USGS response to the hurricanes of 2005. U.S. Geological Survey Circular 1306. http://pubs.usgs.gov/circ/1306/. Last accessed on May 28, 2013.

Federal Emergency Management Agency (FEMA). WYO and Direct Data by Community with County and State. 1/28/2013.

Fox, David M., P.C. Stouffer, D.A. Rutherford, W.E. Kelso, M. La Peyre, R. Bambarger. 2007. Impacts of a Freshwater Diversion on Wildlife and Fishes in the Maurepas Swamp. Prepared for: U.S. Environmental Protection Agency Region 6. Prepared by: Louisiana State University, School of Renewable Natural Resources.

Frazier, D. E. 1967. Recent deltaic deposits of the Mississippi River, their development and chronology. Transactions Gulf Coast Association of Geological Societies 17:287-315.

Garrison, C.R. 1999. Statistical Summary of Surface-Water Quality in Louisiana—Lake Pontchartrain-Lake Maurepas Basin, 1943-95. Louisiana Department of Transportation and Development Water Resources Technical Report No. 55G. http://la.water.usgs.gov/publications/pdfs/TR55G.pdf. Last accessed on May 22, 2013.

Gulf of Mexico Fishery Management Council (GMFMC). 2004. Final Environmental Impact Statement for the generic essential fish habitat amendment to the following fishery management plans of the Gulf of Mexico: shrimp fishery of the Gulf of Mexico, red drum fishery of the Gulf of Mexico, reef fish fishery of the Gulf of Mexico, stone crab fishery of the Gulf of Mexico, coral and coral reef fishery of the Gulf of Mexico, spiny lobster fishery of the Gulf of Mexico and South Atlantic, coastal migratory pelagic resources of the Gulf of Mexico and South Atlantic. Gulf of Mexico Fishery Management Council. Tampa, Florida. http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/Final%20EFH%20EIS.pdf

Gosselink, J.G. 1984. The Ecology of Delta Marshes of Coastal Louisiana: A Community Profile. U.S. Fish and Wildlife Service Report FWS/OBS-84/09. http://www.nwrc.usgs.gov/techrpt/84-09.pdf. Last accessed on May 22, 2013.

Hastings, R.W. 2001. Comparative distribution and abundance of catfishes in an oligohaline upper estuary. Proceedings of the Louisiana Academy of Sciences. Accessed 1 April 2009 at http://findarticles.com/p/articles/mi_hb3536/is_2001_Annual/ai_n28891492/ Last accessed April 1 2009.

Hastings, R.W.. 2009. The Lakes of Pontchartrain: Their History and Environments. Jackson, MS: University Press of Mississippi. 272 pp.

Hoeppner, S.S., G.P. Shaffer, and T.E. Perkins. 2008. Through droughts and hurricanes: Tree mortality, forest structure, and biomass production in a coastal swamp targeted for restoration in the Mississippi River Deltaic Plain. Forest Ecology and Management 256:937-948.

Keddy, P.A., D. Campbell, T. McFalls, G.P. Shaffer, R. Moreau, C. Dranguet, and R. Heleniak. 2007. The Wetlands of Lakes Pontchartrain and Maurepas: Past, Present and Future. Environmental Reviews 15:43-77. http://www.drpaulkeddy.com/pdffiles/Keddy%20et%20al.%202007%20--%20Env%20Revs%20--%20Lake%20Ponchartrain%20Wetlands%20review.pdf. Last accessed May 22, 2013.

Sikora, W.B. and B. Kjerfve. 1985. Factors Influencing the Salinity Regime of Lake Pontchartrain, Louisiana, a Shallow Coastal Lagoon: Analsis of a Long-Term Data Set. Estuaries 8(2A):170-180. http://geotest.tamu.edu/userfiles/167/50.pdf. Last accessed on May 22, 2013.Kryter, K.D. 1994. The Handbook of Hearing and the Effects of Noise. Academic Press, San Diego, CA.

Landry, Jr., S.P. 1967. Frenier Beach Hurricane Storm Surge Revisited. Volume 39, Number 4, July/August 1996 of the *Consultant*.

Lane, R.R., H.S. Mashriqui, G.P. Kemp, J.W. Day. J.N. Day, and A. Hamilton. 2003. Potential nitrate removal from a river diversion into a Mississippi delta forested wetland. Ecological Engineering 20:237-249.

Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority. 1998. Coast 2050: Toward a Sustainable Coastal Louisiana. Louisiana Department of Natural Resources. Baton Rouge. LA. 161 p

Louisiana Department of Environmental Quality (LDEQ). 2011. Lower Amite River Watershed TMDL for Biochemical Oxygen-Demanding Substances-Phase I. http://www.deq.louisiana.gov/portal/portals/0/technology/tmdl/pdf/Final_Lower_Amite_River_040303_TMDL_Report_03302011.pdf. Last accessed on August 13, 2013.

Louisiana Department of Wildlife and Fisheries (LDWF). 2005. WMA Maurepas Swamp. http://www.wlf.louisiana.gov/hunting/wmas/wmas/list.cfm?wmaid=58. Last accessed May 22, 2013.

———. 2013. Maurepas Swamp WMA. http://www.wlf.louisiana.gov/hunting/wmas/wmas/list.cfm?wmaid=58. Last accessed May 22, 2013

———. 2013. Louisiana State Threatened and Endangered Species and Rare and Unique Habitats Coordination. http://www.wlf.louisiana.gov/wildlife/species-parish-list?tid=259&type_1=fact_sheet_animal. Last accessed June 6, 2013.

Loden, M. S., 1978. Life history and seasonal abundance patterns of aquatic Oligochaeta in four southeastern Louisiana habitats. Ph.D. Thesis, Louisiana State Univ., Baton Rouge, 132 pp.

Mitsch, W.J., and J.G. Gosselink. 1993.Wetlands. Van Nostrand Reinhold, New York. 722 pp.

———. 2000. Wetlands, 3rd Edition. John Wiley & Sons, Inc. New York. 920 pp.

Moody's Analytics. 2008. Historical Data and Future Projections for the Parishes of Louisiana. 12/28/2008.

Moody’s. 2013. Moody’s Analytics. Economy.com. Last accessed June 6, 2013.

Mousavi, M.E., J.L. Irish, A.E. Frey, F. Olivera, and B.L. Edge. 2011. Global warming and hurricanes: the potential impact of hurricane intensification and sea level rise on coastal flooding. Climate Change 104:575-597.

National Oceanographic and Atmospheric Administration (NOAA). 2013. NOAA Fisheries Habitat Conservation Division Essential Fish Habitat website. http://sero.nmfs.noaa.gov/hcd/efh.htm. accessed August 14, 2013

National Oceanic and Atmostpheric Administration (NOAA). 2013a. Hurricane tracks within 65 nautical miles of Laplace, Louisiana http://csc.noaa.gov/hurricanes/# accessed August 14, 2013.

———. 2013b. Mean tidal range at New Canal USGS station, Lake Pontchartrain. http://tidesandcurrents.noaa.gov/tides09/tab2ec4.html Accessed August 14, 2013

Natural Resources Conservation Service (NRCS). 2013. National Soil Survey Handbook, Title 430-VI. Available online at http://soils.usda.gov/technical/handbook/. Accessed: May 23, 2013.

National Wetland Research Center (NWRC). 2013. West Shore Lake Pontchartrain FIS-EIS, Habitat Analysis Map. Map ID: USGS-NWRC 2013-11-0021, Map Date: May 02, 2013. Map produced by U.S. Department of the Interior, U.S. Geological Survey, National Wetlands Research Center, Coastal Restoration Assessment Branch, Baton Rouge, LA

Odum, E.P. 1980. The status of three ecosystem-level hypotheses regarding salt marsh estuaries. Tidal subsidy, outwelling and detritus based food chains. Pages 485–495 in V.S. Kennedy (ed.) Estuarine Perspectives, Academic Press, New York.

Patil, A. and Z.Q. Deng. 2008. Watershed Scale Variation in Water Quality in Lake Pontchartrain Basin. From American Society of Civil Engineers World Environmental and Water Resources Congress 2008. http://ascelibrary.org/doi/pdf/10.1061/40976%28316%29641. Last accessed on May 22, 2013.

Penland, S., A. Beall and J. Kindinger, eds. 2002. Environmental Atlas of the Lake Pontchartrain Basin. New Orleans, LA: Lake Pontchartrain Basin Foundation. U.S. Geological Survey Open File Report 02-206.

Philomena, A.L. 1983. The Distribution of Macrobenthos in Barataria Basin, Louisiana. Louisiana State University, Baton Rouge 280 pp.

Poirrier, M.A., E.A. Spalding,, and C.D. Franze, 2009. Lessons learned from a decade of assessment and restoration studies of benthic invertebrates and submersed aquatic vegetation in Lake Pontchartrain. Journal of Coastal Research, SI(54), 88–100. West Palm Beach (Florida), ISSN 0749-0208.

Saucier, R. R. 1963. Recent Geomorphic History of the Pontchartrain Basin. Coastal Studies Series No. 9. Louisiana State Univ. Press, Baton Rouge, Louisiana. 114 p.

Shaffer G.P., Thaïs E. Perkins, Susanne Hoeppner, Susan Howell, Heath Benard, and A. Carol Parsons. 2003. Ecosystem Health of the Maurepas Swamp: Feasibility and Projected Benefits of a Freshwater Diversion. Prepared for: The U.S. Environmental Protection Agency. 105 pp.

Shaffer, G.P., W.B. Wood, S.S. Hoeppner, T.E. Perkins, J. Zoller, and D. Kandalepas. 2009. Degradation of Baldcypress-Water Tupelo Swamp to Marsh and Open Water in

Southeastern Louisiana, U.S.A.: An Irreversible Trajectory? Journal of Coastal Research, Special Issue 54:152-165

Sikora, W.B., and B. Kjerfve. 1985. Factors Influencing the Salinity Regime of Lake Pontchartrain, Louisiana, a Shallow Coastal Lagoon: Analysis of a Long-Term Data Set. Estuaries Vol. 8, No. 2A, p. 170–180.

Snedden, G.A., and Swenson, E.M., 2012, Hydrologic index development and application to selected Coastwide Reference Monitoring System sites and Coastal Wetlands Planning, Protection and Restoration Act projects: U.S. Geological Survey Open-File Report 2012–1122, 25 p.

Stouffer, P.C., and J.A. Zoller. 2006. Use of Lake Maurepas Wetlands by Migrating Birds. PBRP Research. Highlight. http://www2.selu.edu/orgs/pbrp/redesign_documents/PBRP_RH_4.pdf. Last accessed on May 22, 2013.

Stone, J.H., N.A. Drummond, L.L. Cook, E.C. Theriot, and D.M. Lindstedt. 1980. The distribution and abundance of plankton of Lake Pontchartrain, Louisiana, 1978. Pp437-590 in J.H. Stone, ed. Environmental Analysis of Lake Pontchartrain, Louisiana, Its Surrounding Wetlands, and Selected Land Uses. Fols 1 and 2. Publication no. LSU-CEL-80-089. Center for Wetland Resources, LSU Baton Rouge.

Swarzenski, C.M., T.W. Doyle, and T.G. Hargis. 2005. Pore-Water and Substrate Quality of the Peat Marshes of the Barataria Preserve, Jean Lafitte National Historical Park and Preserve, and Comparison with Penchant Basin Peat Marshes, South Louisiana, 2000-2002. USGS Scientific Investigations Report 2005-5121. http://water.usgs.gov/nps_partnership/jela.php. Last accessed on May 22, 2013.

Tate, J.N., A.R. Carrilo, R.C. Bergeer, and B.J. Thibodeaux. 2002. Salinity Changes in Pontchartrain Basin Estuary, Louisiana, Resulting from Mississipppi River-Gulf Outlet Partial Closure Plans with Width Reduction. Technical Report ERDC/CHL TR-02-12. Vicksburg, MS: U.S. Army Engineer Research and Development Center. http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA408114. Last accessed on May 22, 2013.

Tinkle, D.W. 1955. Observations of reptiles and amphibians in a Louisiana swamp. Texas Tech College, Lubbock, Texas. 17 pp.

Turner, R.E., Q. Dortch, D. Justic, and E.M. Swenson. 2002. Nitrogen loading into an urban estuary: Lake Pontchartrain (Louisiana, U.S.A.). Hydrobiologia 487:137-152.

U.S. Census Bureau (USCB). State and County Quick Facts. http://quickfacts.census.gov/qfd/states/22/22095.html; http://quickfacts.census.gov/qfd/states/22/22089.html; http://quickfacts.census.gov/qfd/states/22/22093.html Last accessed on August 14, 2013..

U.S. Army Corps of Engineers (USACE). 2004. Louisiana Coastal Area (LCA) Ecosystem Restoration Study. November 2004. Final. Volume 2: Programmatic Final Environmental Impact Statement.

———. 2008. Integrated Final Report to Congress and Legislative Environmental Impact Statement for the Mississippi River – Gulf Outlet Deep-Draft De-authorization Study Volume 1 MAIN REPORT. USACE, New Orleans, LA November 2007 (Revised June 2008)

———. 2010a. Louisiana Coastal Area Ecosystem Restoration Study Volume IV of VI Final Integrated Feasibility Study and Supplemental Environmental Impact Statement for the Small Diversion at Convent/Blind River, St. James Parish, Louisiana. October 2010.

———. 2010b. Louisiana Coastal Area Ecosystem Restoration Study Volume II of VI. Final Integrated Feasibility Study and Supplemental Environmental Impact Statement for the Amite River Diversion Canal Modification Ascension and Livingston Parishes, Louisiana. December 2010.

———. 2013. Final, Volume I, Comprehensive Environmental Document, Phase I, Greater New Orleans Hurricane and Storm Damage Risk Reduction System. U.S. Army Corps of Engineers, New Orleans District, Louisiana, May 2013

U.S. Department of Agriculture (USDA). 2013. Soil Survey: St. James and St. John the Baptist Parish, Louisiana. http://soils.usda.gov/survey//online_surveys/louisiana/stj-stjbLA1973/StJ-StJB.pdf. Accessed March 28, 2013.

U.S. Environmental Protection Agency (USEPA). 2012. Stormwater Pollution Prevention Plans for Construction Activities. http://cfpub.epa.gov/npdes/stormwater/swppp.cfm. Last accessed on May 22, 2013.

U.S. Geological Survey (USGS)/National Wetland Research Center. 2000. Nutria, Eating Louisiana's Coast. http://www.nwrc.usgs.gov/factshts/020-00.pdf. Last accessed on May 22, 2013.

Wekeley, J.S., and T.H. Roberts. 1996. Bird distribution and forest zonation in a bottomland hardwood wetland. Wetland 6: 296–308.

Watson, M.B., C.J. Killebrew, M.H. Schurtz, and J.L. Landry. 1981. A Preliminary Survey of Blind River, Louisiana. In L.A. Krumholtz, ed. The Warmwater Fisheries Symposium, A National Symposium on Fisheries Aspects of Warmwater Streams. American Fisheries Society, Knoxville, TN. Pp. 303-319.Lee Wilson and Associates, Inc. 2001. Diversion into the Maurepas Swamps. Contract No. 68-06-0067, WA No. 5-02. U.S. Environmental Protection Agency, Dallas, TX.

Wu, K and Y.J. Xu. 2007. Long-term freshwater inflow and sediment discharge into Lake Pontchartrain in Louisiana, USA. Hydrological Sciences Journal 52(1):166-180.

Zganjar, C., G. Frierson, K. Westphal, P. McCarty, S. Bridges, S. Penland. 2002. Environmental Atlas of the Lake Pontchartrain Basin. http://pubs.usgs.gov/of/2002/of02-206/env-issues/change-maurepas.html. Last accessed May 20, 2013.

Zoller, J. A. 2004. Seasonal differences in bird communities of a Louisiana swamp and manipulation of the breeding density of Prothonotary warblers. M.S. Thesis, Southeastern Louisiana University, Hammond, LA, USA.

WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

Annex C

Index